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ABSTRACT

The use of information technology within independent colleges is examined by analyzing data from an annual survey by the College Entrance Examination Board and one completed by the Council of Independent Colleges (CIC) members, developed by CAUSE, the national association for the management of information in higher education. The questionnaire was completed by 119 members, a response rate of 38.3%. Findings indicated that senior academic officers appear to be in pivotal positions regarding the possible integration of educational computing, administrative computing, and library information. Eighty-one percent of respondents had a campus strategic plan, and 47 percent had an information technology plan, but few campuses link the two. Investments in information technology represented a significant part of members' discretionary revenue, but members typically invested less than 2% of educational and general budgets in computing and less than 3% in libraries. CIC colleges compared well to other independent colleges and very well to public institutions with respect to information technology, but they were less likely to be connected to the Internet. Few campuses had the latest in high-end facilities. Thirty-eight figures (graphs) present survey findings. An appendix discusses survey responses. (SLD)

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#1
in a Series of Papers
on
nformation Technologies

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Independent Colleges

Information Technologies in Independent, Liberal Arts Colleges

A Summary and Analysis of Comparative Data

by

Edward J. Barboni
September, 1993

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TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

In 1992, under a grant from the Buhl Foundation, CIC began a project to help independent colleges make decisions about the purchase and use of information technologies, including administrative and educational computing, library automation, telecommunications, video, and networking. The project stems from insights gained over the past four years in an annual spring Information Technologies Workshop that CIC has sponsored in Pittsburgh with CAUSE and EDUCOM, the two national higher education organizations concerned with information technologies, and with the regional Consortium for Computing in Undergraduate Education (C-CUE).

The project is based on the premise that *access* to resources can be more cost effective than *acquisition*. Specifically, it seeks a detailed understanding of institutional needs in this area, provides information for colleges about information technologies, promotes the benefits of connecting to national electronic networks, represents the collective interest of colleges to technology vendors and national computing organizations, and develops ways to offer support for decisions that senior administrators must make.

This paper is the first in a series emerging from the project. It is authored by Edward J. Barboni, CIC Senior Associate and director of this project. Dr. Barboni was formerly director of technology integration for the NASA Classroom of the Future and the National Technology Transfer Center at Wheeling Jesuit College, and is past vice president for planning and information at Allegheny College.

Our deep thanks go to The Buhl Foundation, and its president, Doreen E. Boyce, for the grant support that has enabled CIC to launch this vitally important effort.

We also wish to thank CAUSE and its vice president for information resources, Mike Zastrocki, for offering its questionnaire for our use to gather information about the use of technology on member campuses. Special thanks go to the 120 people who took the time to carefully fill out the lengthy, comprehensive questionnaire. Without their time and effort we would not have been able to learn as much as we have about the use of information technologies on our member campuses.

Information technologies is a particularly fast-moving field, and therefore this series of papers can be viewed not as the definitive word, but as part of an ongoing dialogue. We encourage all readers to become a part of this dialogue. Let us know what issues concern you, and where in this arena you would like to see CIC address its attention.

Allen P. Splete
President
September, 1993

Information Technologies in Independent, Liberal Arts Colleges

A Summary and Analysis of Comparative Data

by

Edward J. Barboni
September, 1993

This first report in the Information Technology series surveys the present use of information technologies within independent colleges, using data from an annual survey by the College Entrance Examination Board and a summer, 1992, survey conducted jointly by CIC and CAUSE, the national association for the management of information in higher education.

The paper also makes the case for an overall strategy for independent colleges of access to rather than acquisition of many key resources. Information technologies can be the mechanism to achieve such access.

Let CIC hear from you...

This report is not CIC's final word on this subject. So we hope you will treat it as part of an ongoing conversation. Let us hear from you. The four annual workshops in Pittsburgh have started the conversation; this report extends it; your comments and future reports and workshops will continue it.

What additional information do you need as you purchase and use information technologies? How might CIC help?

Contact Ed Barboni or leave a message at the CIC offices (One Dupont Circle, Suite 320, Washington, D.C. 20036; (202) 466-7230; fax: (202) 466-7238). You may reach Ed at:

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Executive Summary

- Senior academic officers appear to be in pivotal positions regarding possible integration of educational computing, administrative computing, and library information.

- 81% of respondents have a campus strategic plan and 47% have an information technologies plan. However, few campuses link their information technology plans to their campus strategic plans or to budgeting and few update their technology plans regularly.

- Investments in information technology represent a significant percentage of *discretionary* revenue. However, respondents typically invest less than 2% of E&G in academic and administrative computing combined and less than 3% of E&G in their libraries.

- Personnel support is sparse—well over half the respondents have less than 4 FTE (full-time equivalent) administrators per 1,000 students for academic and administrative computing combined.

- CIC colleges compare well to other 4-year, independent colleges and very well to public universities and 2-year colleges with respect to access to information technologies.

- A much smaller percentage of CIC members are connected to the nation's Internet than are competitors. Without careful, aggressive planning this could turn into a serious marketing problem in both student and new faculty markets.

- There are very few campuses with any presence of high-end IBM-compatibles (486 machines), Apple Computers (Quadras), or UNIX workstations. This presents problems regarding the use of emerging software that has the greatest potential for integration with teaching and learning.

- Most CIC colleges, unlike many of their wealthier competitors, have not made major investments in what are rapidly becoming outdated networks. This offers CIC members a competitive advantage if they carefully plan for the implementation of emerging technologies which offer the greatest hope for integrating information technologies with learning and teaching.

- Careful planning in the use of networks will provide CIC members with a tremendous opportunity to gain access to robust resources which traditionally have been unavailable to college faculty and students or too expensive to acquire directly.

- CIC members are well positioned to adopt a distributed, heterogeneous, user-centered model for information technologies.

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Introduction

During the spring of 1992 CIC surveyed its members regarding the use of computing and telecommunications technologies on their campuses. We used a questionnaire developed by CAUSE, the national association dealing with the management of information in higher education, to gauge the type of technologies CIC members use and the extent to which they use them. With the information we have collected we can begin to understand how and why our members use information technologies on their campuses.

CIC colleges emphasize the importance of teaching and learning in their missions. Scholarship is also emphasized, often as a means to enhance teaching. All of our members value community service and seek to provide opportunities for the professional development of their faculties. So, if we are ultimately to assess whether our investments in information technologies have yielded commensurate benefits, then we must assess whether these investments have enhanced our students' ability to learn, our faculty's ability to teach and conduct scholarship, and our ability to function as communities of learners. These are difficult issues to assess. However, we will attempt throughout this report to address them to the extent possible.

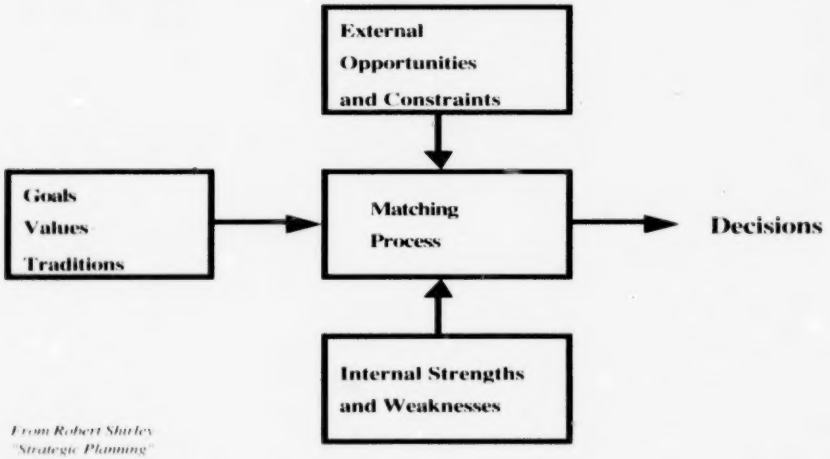
As the above suggests, this report will focus on the use of information technologies for educational purposes. We will at times address administrative computing issues but for the most part only to create a context for educational computing.[1] The report begins with a discussion of planning for the use of information technologies on member campuses. We turn next to a discussion of management and budgetary issues. We end the report with a close look at the use of microcomputer technologies on our members' campuses.

PART I: Planning, Staffing, and Finances

Planning

Strategic planning, as illustrated in the following figure, is essentially an ongoing process of matching a college's internal strengths and weaknesses to its external opportunities and constraints in the context of its goals, values, and traditions. The outcomes of the process are decisions about the college's future. This view of planning emphasizes the trade-offs in which decision-makers are constantly engaged as well as the need for treating planning in the area of information technologies in the context of overall institutional planning. It also suggests that planning about information technologies should be tied directly to a college's overall goals and build on its traditions and values.

Strategic Planning

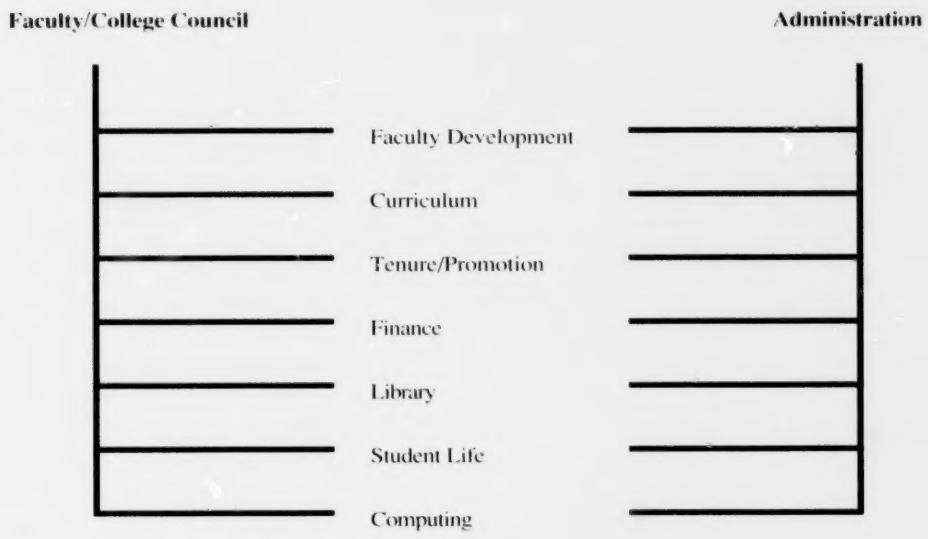


From Robert Shirley "Strategic Planning"

[1] The CAUSE questionnaire does contain a great deal of information regarding administrative computing which will be a focus of a subsequent report.

On most campuses, except for times when the energies of an entire campus are galvanized for a major strategic planning effort, planning regarding information technologies usually takes place in an academic computing committee. In our experience, this is not an ideal environment to plan for the expenditure of significant resources. In practice, academic computing committees tend to focus narrowly on technological issues (e.g., whether to buy Macintoshes or IBM-compatibles, whether to standardize on WordPerfect or Microsoft Word, etc.) rather than on how best to meet a college's overall goals (e.g., maximize opportunities for professional development, increase the diversity of the students with whom a college's students interact, etc.). While this is not surprising, it is unfortunate. We believe it is largely due to the committee structures which most colleges create and the lack of ongoing communication among committees. The following figure illustrates this point.

Committee Structure/Governance

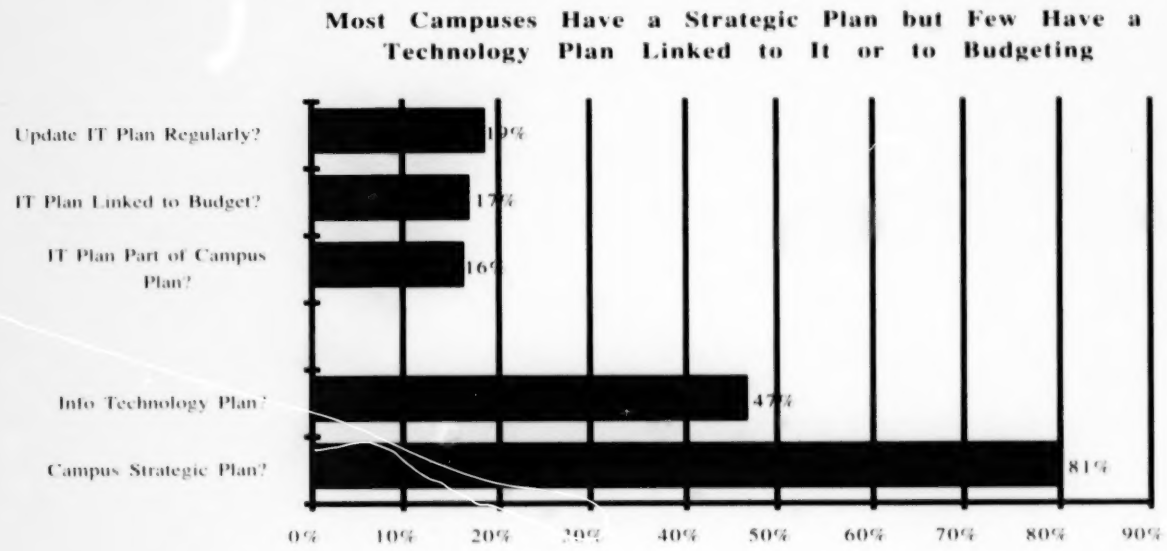


Typically committees responsible for faculty development, the curriculum, or student life, for example, rarely provide members of a computing committee with *explicit* guidance regarding the goals the former believe to be important. Equally important, computing committees seldom provide other committees with the kind of information they would need to make useful trade-offs concerning means to achieve important institutional goals. For example, how often does a faculty development committee have the opportunity to weigh the benefits/costs of connecting to the nation's Internet against adding a small amount to each faculty member's travel budget? For some colleges, connection to the Internet may create many more opportunities for their faculty to interact meaningfully with their colleagues nationally than would the addition of $100 per year to faculty travel budgets. Another example relates to how students learn. How often is software or hardware *explicitly* selected in the context of a systematic analysis of the different ways in which students learn?

Among the most important parts of planning is financial planning—relating institutional goals and the means to achieve them to their respective costs. This is a matching process which should provide the opportunity to make trade-offs among the many competing means to achieve important institutional goals. Yet this process rarely occurs on an ongoing basis with respect to allocation of resources for computing. In short, computing is often treated as if it is an end in itself because it is often not firmly and routinely embedded in debate regarding institutional goals and it is not held accountable to rigorous benefit/cost analysis relative to competing means to achieve those goals.

Another way to say this is that, in the absence of systematic, critical assessment of the role that computing should play in achieving a college's substantive goals in the context of its traditions and values, discussions regarding computing often devolve to the "more, faster, bigger is better" syndrome. Some of the language we will use in the remainder of this report may suggest that this is our view. It is not.

How is planning for information technologies linked to other planning processes on our members' campuses? We find the vast majority of respondents to the CIC/CAUSE survey had a strategic plan for their campuses (81%) and nearly half (47%) had a strategic plan for information technology.[2]



However, very few respondents' information technology plans were linked to their overall campus planning processes in any meaningful way. Equally important, only about a fifth of the respondents update their information plans regularly, suggesting that planning for information technologies is episodic for most campuses rather than an ongoing process. Perhaps most troublesome is that only seventeen percent of the respondents link planning for information technologies to budgeting.

In these respects, colleges are not unlike corporations. For several decades American corporations invested extensively in information technologies in the belief that such investment would lead to increased productivity. While this may have been true with respect to the automation of manufacturing processes, it has generally not been true among office workers. (For that matter, corporations are learning that the automation model no longer works for the factory floor either.) In fact, white collar productivity declined while these investments in technology were being made. We would argue that this resulted partially from the misplaced belief that the work of learning (about one's corporation so that one can make better decisions) does not lend itself well to a hierarchical automation model. As corporations became more dependent upon information and the work of learning for their success it became increasingly clear that the hierarchical model was inappropriate. Simultaneously, major technological advances in the computer industry made possible a radical shift in the way information technologies could be used to enhance knowledge workers' productivity. These parallel changes are illustrated in the following two figures.

[2] The representativeness of the respondent pool is addressed in detail in the Appendix. Suffice it to say here that the respondents are quite similar to the non-respondents in many respects regarding aspects of computing for which we have comparative data. However, the reader should assume that we are referring to the respondents only throughout this report.

The *Organization* Model Has Changed Substantially

	Then	New Ideal
Organization	Hierarchy of Individuals	Flat - Clusters of Work Groups
Orientation	Provincial & Inward Looking	Multi-national & Outward Looking
Resources	Centralized	Decentralized
Information	Unidimensional & Static	Multidimensional & Dynamic
Concept of Work	Automated	Professionalized
Focus on	Task	Project

The *Computer* Model Has Changed Substantially

	Then	New Ideal
Organization	Homogeneous Mainframe/Mini	Seamless Heterogeneous Network
Orientation	User Conforms to Machine	Machine Conforms to User
Resources	Centralized	Distributed
Information	Character-Based & Static	Multiple Media & Dynamic
Concept of Work	Isolated, Automated Individuals	Integrated Groups of Professionals
Focus on	Application	Project

Neither the change in industry nor the change in the computer industry has occurred without pain. Increased global competition, the shortening of product development cycles, and increased reliance on information for success have combined to lead to what is politely called restructuring and right-sizing. What it really means is groups of knowledge workers using modern technology can now be more productive than their hierarchically organized predecessors. As a consequence of all these forces, corporations are laying off in record numbers people who never imagined their jobs to be in jeopardy. The indications are that these are not short-term layoffs; many would argue that these jobs are gone forever. However, they would also argue that entirely new types of jobs in new industries can emerge as the American economy adapts to increased competitiveness and increased reliance upon information to compete successfully.

It is ironic that, in many respects, the descriptors which we have applied to the "new ideal" corporation have for quite some time applied to the work of learning in our colleges. Yet the corporate world seems to be adapting changes in information technology to changes in their organizational structures more quickly than colleges have to their long-standing model of a "flat" organization. We believe this has occurred largely because it is easier to assess outcomes in the corporate world than it is in education. For example, it is much easier, although still difficult, to adopt total quality management principles and statistical quality control in industry than it is to assess whether students really understand, for example, mathematical abstractions.

The benefits of implementations of new technologies in the corporate world can be assessed in the context of the "bottom line." Implementations of new technologies in education are much more difficult to assess. However, as the increased demand for accountability in higher education indicates, we must finds ways to implement new technologies creatively in a context of growing financial constraints.

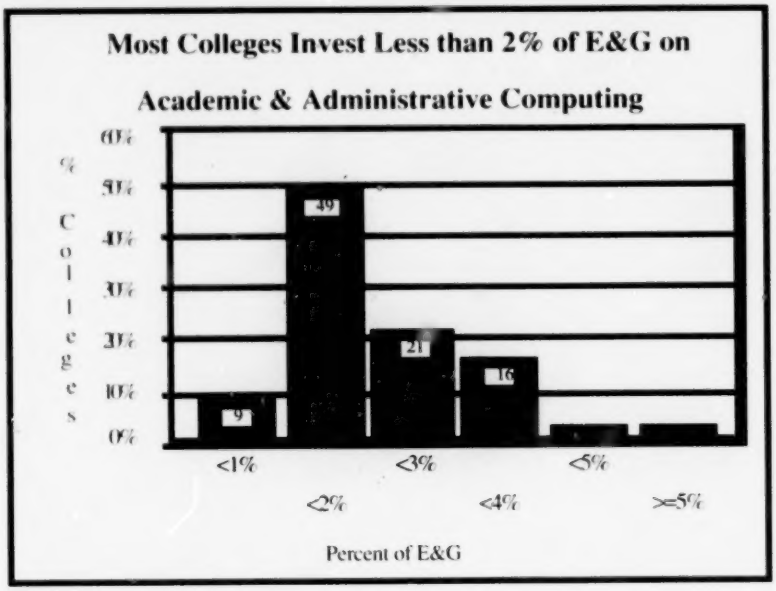
From a more positive perspective, there is much we can learn from the mistakes and the successes of corporations as they move from a hierarchical organization and computing model to a distributed and dynamic model of organizations and information technologies. There is very strong evidence from the corporate world and from colleges who have begun to adopt the distributed computing model that the work of learning is vastly enhanced when this transition is carefully planned and linked directly to institutional goals and priorities. The new ideal of the seamless, heterogeneous network in which computers conform to users' needs, resources are distributed and accessible across the network, and information of all types, in forms useful to learning, is now within the reach of small colleges. Implementing this approach to information technologies provides benefits well beyond the increase of individual productivity provided by the stand alone microcomputer and/or central minicomputer model of the past. By implementing emerging easy-to-use, inexpensive software over a network, colleges can vastly increase the capacity for faculty and students to collaborate among themselves in fluid and powerful ways. A not incidental outcome of this approach to information technologies can also be increased cohesion within the communities we call colleges.

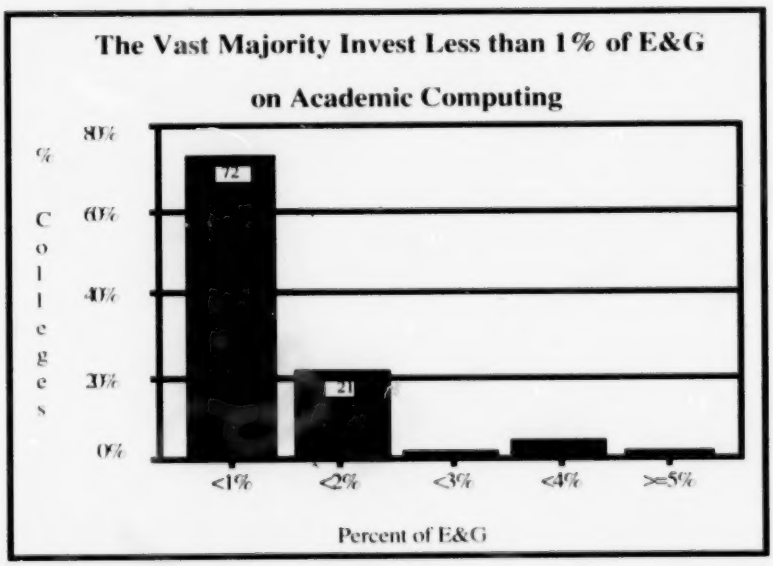
Reaping the benefits of these powerful technologies is not easy. In fact, because of their power, it is now much easier to do a great deal of damage to the educational enterprise with them. They can be used (and are being used) in some corporations and on some campuses to even more rigorously automate individuals. For example, the model of productivity on many (if not all) large state university campuses is to increase (the already) large number of students to which a single professor can "transfer information." The larger this number, the theory goes, the greater the productivity. Modern information technology, particularly in a networked environment, can easily be used to further automate the transfer of information to large numbers of students. Whether this should be referred to as an improvement in the process of learning is debatable.

Our belief is that liberal arts colleges distinguish themselves in many ways from other institutions and one of their most distinguishing characteristics is the intensely personal interaction which they encourage among their students and faculty. The process of learning which this kind of interaction encourages is our focus here, and we will return to its characteristics repeatedly throughout this report. At this point, however, it would be useful to turn to some of the financial issues associated with reaping the benefits of modern information technologies.

Investing in Information Technologies

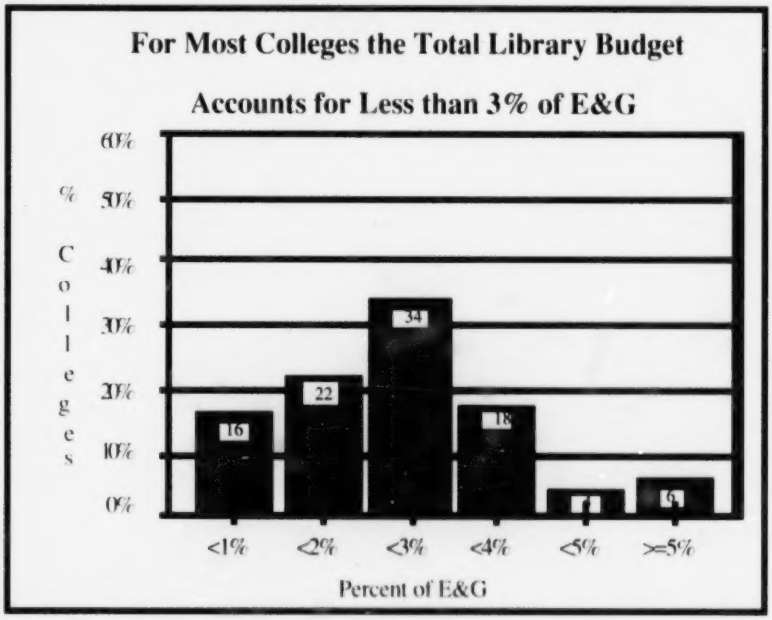
Most respondents are currently investing less than two percent of their educational and general budgets on academic and administrative computing combined.[3] Of this two percent less than half is currently being invested in academic computing.





[3] The experience that both CAUSE and we have had regarding knowledge of E&G budgets among computing personnel suggests that one should interpret these results with caution. There is often misunderstanding in this area, and these data are probably subject to error in reporting. However, the overall patterns are probably reasonably good indicators of investments in computing at the responding colleges. Computing budgets, as defined by the questionnaire, include expenditures on hardware, software, salaries, wages, benefits, and all other expenditures for computing.

In comparison to investments in computing, library budgets typically account for less than three percent of education and general budgets. For most respondents, then, the library budget accounts for about one percent more of E&G expenditures than the combined budget for academic and administrative computing and for approximately two percent more than expenditures for academic computing.



As another point of comparison, members of the CLAC[4] consortium of liberal arts colleges typically target five percent of E&G for library and for combined academic and administrative computing expenditures.

This last comparison points to the competitive nature of our current environment—wealthier colleges are investing more of their "larger pie" on information technologies. However, this does not necessarily suggest a worsening competitive environment for CIC colleges. It has been our experience (gained from participation in the past four CIC Pittsburgh Information Technologies Workshops and a number of CLAC meetings over the years) that CIC colleges are quite innovative relative to their often wealthier peers. With respect to investments in information technologies, allow us to offer two suggestions which may provide a bit more perspective on the issue.

Access versus Acquisition

"Access versus acquisition" of resources is likely to become a powerful concept in higher education as financial constraints continue to tighten in the years ahead. In the past, colleges usually acted on the principle that creating access to important resources required acquiring them for use on campus. With the tremendous growth of the nation's Internet and the growing prevalence of campus-wide computer networking, this no longer needs to be the case in the areas of information resources and technologies.

While respondents may invest relatively small proportions of their E&G budgets in information technologies, it is certainly the case that these investments represent a significant proportion of what we would call discretionary budgets.

[4] CLAC is a consortium of approximately fifty of the nation's leading liberal arts colleges. They typically have substantially larger endowments than CIC member colleges and charge significantly higher tuition and fees.

As a consequence, arguing that we should simply invest more in information technologies in order to be more competitive is an inappropriate first-order response to the problem. Rather, we should attempt to maximize the value of the investments we already make. One way to do this is by following the principle of access versus acquisition.

Strategic investments in campus-wide networking and Internet access now make it possible to "level the playing field" substantially among colleges and universities by making powerful information and computing resources available to all campuses that connect to the Internet. For example, it is now possible for students and faculty across CIC's membership to use supercomputing resources at the nation's supercomputing centers for teaching and research. With careful planning, our students and faculty can use these resources just as if they were located on their desktops. Similar arguments can be made for dramatically increasing our faculty's opportunities to engage in professional discourse with their colleagues around the nation and the world and for gaining access to incredibly rich information resources in disciplines across the liberal arts.

The keys to reaping these benefits are to first gain an understanding of what is available and then target investments to gain access to them. As we will discover below, careful planning can help ensure that our institutions have full on-campus access to powerful information technologies and resources.

Growth by Substitution

A concept related to "access versus acquisition" is "growth by substitution." This concept has received a great deal of attention in higher education circles. However, it has rarely been systematically implemented. The reason is fairly straightforward: growth by substitution requires a systematic decision making (planning) process which is institution wide and focuses on clearly defined institutional goals—the kind of planning process described in an earlier section.

Essentially, those who employ growth by substitution successfully create a clear consensus on institutional priorities and a clear understanding of the alternative means to achieve them. One small example of growth by substitution is in the area of professional development. It illustrates the relationship of this concept to access versus acquisition.

Typically, CIC members are not in a position to provide anywhere near the amount of support they would like for faculty travel to professional meetings. An equally vexing problem for many is how to coax some members of their faculties to attend professional meetings at all.

After listening to the "open mike" discussion at the most recent CIC Deans Institute it became clear that a great deal of what the deans were concerned about was creating opportunities for their faculties to have access to developments in their fields. This can be accomplished in a number of ways: faculty travel and journal subscriptions are two traditional avenues. However, as faculty on campuses across the country (including faculty who rarely attended professional meetings in the past) have discovered, user-friendly, convenient (i.e., from their desktops) access to the Internet allows them to remain in constant touch with developments in their fields and with colleagues across the world.

Depending upon a particular college's circumstances it may be a wise decision to divert resources from other areas of the budget to support the networking of faculty offices on campus and then connecting this network to the Internet. It is important to underscore here that the purpose of this diversion of resources would not be to network the campus. The goal would be to increase opportunities for faculty development. One means to accomplish this, among several, would be to create a network of desktop computers connected to the Internet.[5]

There are many other examples of growth by substitution that one could provide. However, this one is sufficient to illustrate how "asking the right questions" may lead to very different solutions to problems than one might have

[5] Returning to the issue of governance; it is not likely that an academic computing committee would be the best place to address these issues.

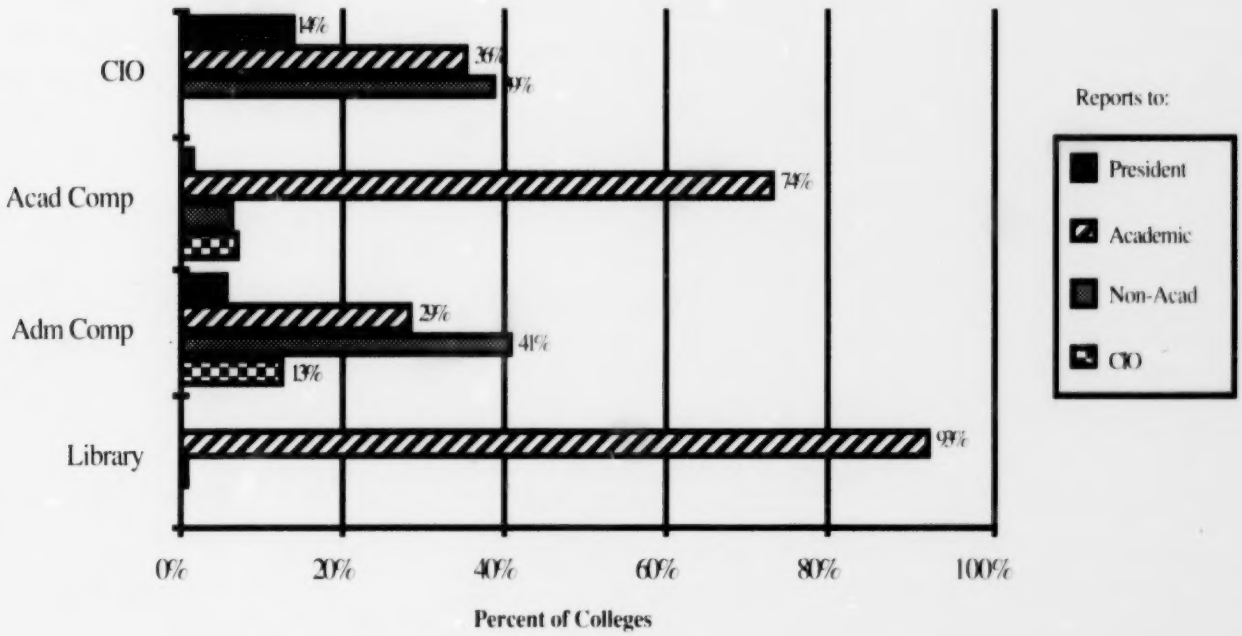
originally anticipated. It also illustrates another point. Computing center staff need to be in a position to know their institution's priorities and be able to act to implement them in concert with those responsible for other means to achieve institutional goals. This requires knowledge, direction, and authority to set and act upon priorities in computing which parallel institutional priorities. This is the antithesis of the situation in which most computing center staffs find themselves. Often they are "out of the loop" responding to a seemingly endless stream of disparate requests from the "users" they are dedicated to serve.

Staffing and Lines of Authority

One method that colleges and universities have chosen to create a greater congruence between institutional priorities and decisions taken in the area of information technologies is to create a senior level position, one which reports to the president, responsible for information technologies. This position is often referred to as the Chief Information Officer (CIO).[6]

Fifty percent of the respondents reported that their college has someone whom they believe functions as a CIO. In contrast, thirty-five percent report that they have a person who is *recognized* as the CIO at their colleges. The titles these individuals bear suggests that, for many, information technologies is not their only responsibility. Respondents report their CIOs bear the title VP for Finance, Academic VP, and other titles as well as titles that suggest responsibility limited to information technologies.

Reporting Lines Vary Substantially



[6] We do not necessarily endorse this approach to solving this problem. In our experience, in the absence of a governance structure that works to ensure good communication and creation of consensus across relevant committees, it is entirely possible for negative consequences to arise out of the creation of a CIO position. It is also possible for the creation of a CIO position to give the *appearance* of change when in fact nothing has changed. In short, creating a process which ensures that decisions regarding computing effectively support institutional priorities requires more than simply creating a position entitled CIO.

It is worth noting that in 1980 CAUSE reported that none of its respondents (representing all of higher education) claimed that their colleges or universities had recognized CIOs. In 1985 the figure rose to three percent. In 1990 it rose dramatically to thirty-five percent. This is a remarkable change in either administrative structures and/or perceptions of the roles that people holding more traditional titles play in decision making regarding information technologies. The figure above suggests that it is perceptions of computing that have changed rather than administrative structures.

Note that only fourteen percent of recognized CIOs report directly to the President. Thirty-six percent of the CIOs report to a chief academic officer. The largest percentage of CIOs (39%) report to a chief administrative officer, usually the vice president for finance and/or administration.

For sixty-five percent of the respondents, academic and administrative computing are treated as separate operations, and recall that administrative computing typically accounts for the largest share of computing budgets. (This is essentially the opposite of the ratio of separate to combined functions found in the most recent CAUSE survey and among CLAC colleges.)

Historically it has been easier to adapt computing to administrative functions, and software specifically tailored to administrative needs has long been available. In contrast, with the exception of personal productivity tools such as word processors, spreadsheets, etc., there has been little software available until very recently that may be used to really make a difference in the learning process.

The separation of administrative from academic computing and the differences among the software utilized in the two areas reflects the historical "cultural" differences between administrative and academic computing. The former is characterized by relatively inflexible schedules, fairly clearly defined end products (e.g., "I need this report"), and relatively severe consequences if a system fails. In contrast, academic computing is often "messy" (in a very positive sense of the term from our perspective), goals are often in flux, and the consequences of a system failure are less severe.

In short, combining these two functions is often quite difficult, and we suspect that many of the combined programs among CIC, CAUSE, and CLAC respondent colleges reflect more a management perspective than the true merging of these two cultures in any substantively meaningful way. We have often found that combining operations simply means sharing clerical staff and having a single manager responsible for the two functions instead of two. Frequently the two areas require different operating systems, creating a situation where systems expertise is difficult to share across the areas. And even in cases where the same word processing and spreadsheet packages are used in the two areas, the "two cultures" problem is an obstacle to effective combining of support functions.

This situation is likely to change over the next decade as administrative work begins to be seen as the work of learning about one's college to enhance decision making. More and more administrators will begin to learn what corporate managers are learning today--providing tools for groups of people to better understand the needs of a corporation and to develop services or products which meet those needs is in fact a learning process. Easy-to-use, powerful computer tools which support this understanding of work in an information-based economy are now being deployed in the corporate sector. It is likely that this view of work will begin to filter into the academic sector in the years ahead, creating the potential for substantively meaningful merging of what have traditionally been called academic and administrative computing.

In the meantime, there is a void between academic and administrative computing. This is evident in the reporting lines for them reported by our survey respondents. Nearly three-fourths of the respondents indicated that academic computing reported to a senior academic officer, while a plurality of respondents (41%) indicated that administrative computing reported to a senior administrative officer. In neither case did as many as ten percent report to the president. Interestingly, however, twenty-nine percent of the respondents indicated that administrative computing reported to a senior academic officer rather than an administrative officer.

In the world of computing much is made of the merging of information technologies. With the rapid automation of libraries, rapidly expanding access to information resources on the Internet and other wide area networks, and the increasing availability of information of all kinds on inexpensive CD-ROMs, attempts have been made to integrate computing with library functions. However, there exist here many of the same kinds of cultural differences between the areas that we alluded to above.

In the context of reporting structures which separate academic computing, administrative computing, and library functions, one of the greatest planning challenges in information technologies facing senior administrators today is gaining an understanding of emerging technologies which bridge the gap between all of these areas by building on a model of "work as learning."

From the data our respondents provided it appears that *senior academic officers* are in the thick of things in this area, yet most academic officers probably feel ill-equipped to tackle these issues. Our suggestion to them is to insist that the people who are responsible for information technologies on their campuses focus not on questions about technology, but on the right questions—about learning, professional development, enhanced communication within a community of learners, and others that deal directly with their missions.

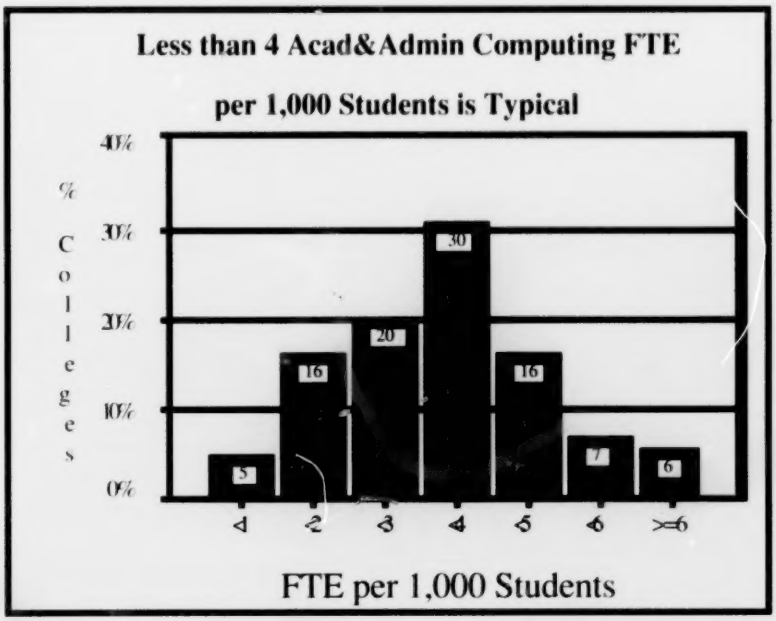
We offer you a simple rule of thumb. If your technology directors cannot convincingly demonstrate how a piece of software or hardware will enhance your ability to meet your college's substantive goals, then don't buy it. A corollary to this principle is simply to refuse to get bogged down in debates about operating systems, brands of microcomputers, network protocols, the technical virtues of different word processors and spreadsheets, and so on. Please do not misunderstand. We believe that information technologies are critically important to our futures because we can use them to make real, positive differences in how our students learn, our faculty teach, and how our colleges are administered. However, our experience has led us to develop a healthy cynicism about the promises that those involved with technology tend to make. There is an old cliché that applies here—"seeing is believing." If you cannot *see the benefits* of what is being proposed after it has been demonstrated to you, it is not likely that those benefits will materialize.

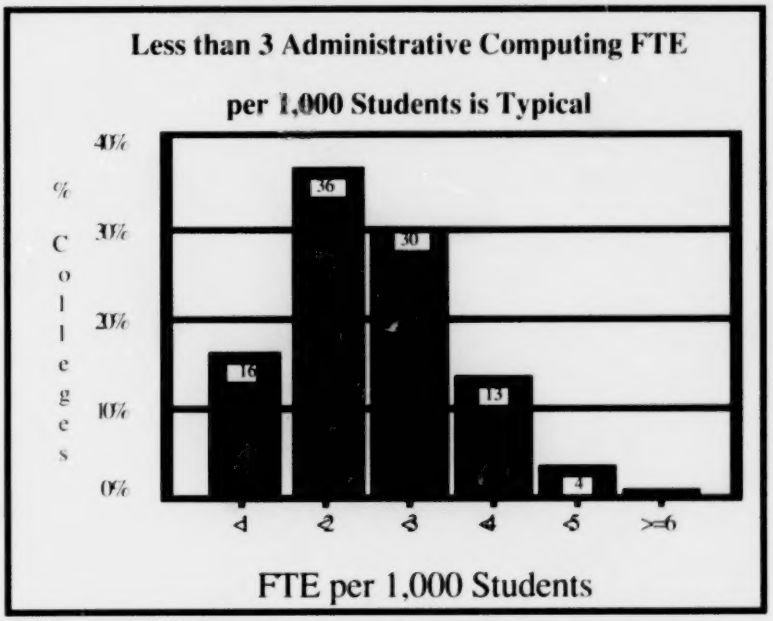
Having said the above, the fact remains that senior administrators are dependent upon their directors for information technologies for advice and to implement decisions taken regarding information technologies. As we will demonstrate below, our respondents indicated that their staffs for information technologies are quite lean and only modestly compensated for the difficult and demanding tasks they face.

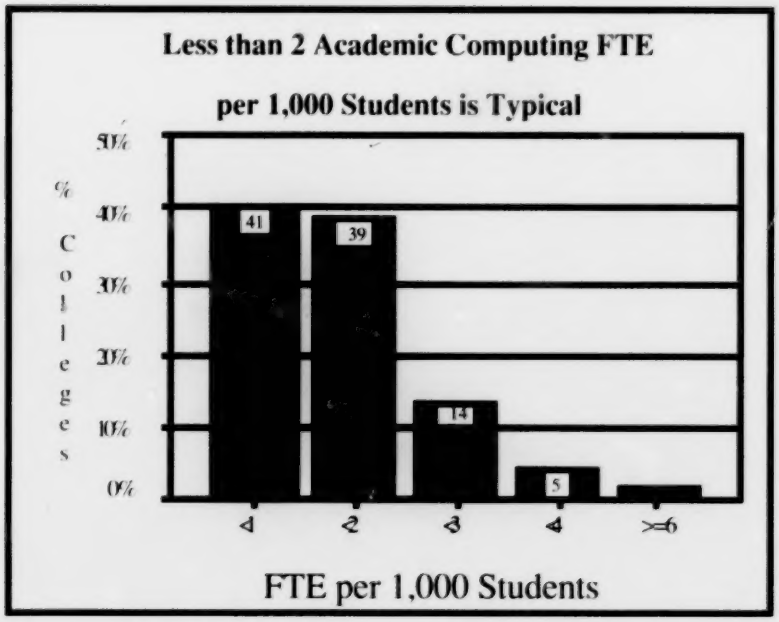
Staff Size

As the following figures illustrate, simply put, CIC staffs for academic and administrative computing are small. (Although, subsequent sections will demonstrate that they have accomplished quite a bit.) Nearly three-quarters have less than four FTEs (full-time equivalent personnel) per one thousand students to support all of their students, faculty, administrators, and staff.[7] Eighty-two percent have fewer than three administrative FTEs per one thousand students. Eighty percent have fewer than two FTEs per one thousand students supporting academic computing, reflecting the greater proportion of budgets devoted to administrative computing.

[7] We used student body size to normalize staff size so we could make more meaningful comparisons among the respondents and to allow readers to compare themselves to the respondents. We did not have information on staff or faculty size to further normalize the data.


Less than 4 Acad&Admin Computing FTE
per 1,000 Students is Typical
% Colleges
40%
30%
20%
10%
0%
5
16
20
30
16
7
6
<4
2-3
4-5
6-7
>=8
FTE per 1,000 Students


Less than 3 Administrative Computing FTE
per 1,000 Students is Typical
% Colleges
40%
30%
20%
10%
0%
16
36
30
13
4
<2
2-3
3-4
4-5
>=6
FTE per 1,000 Students

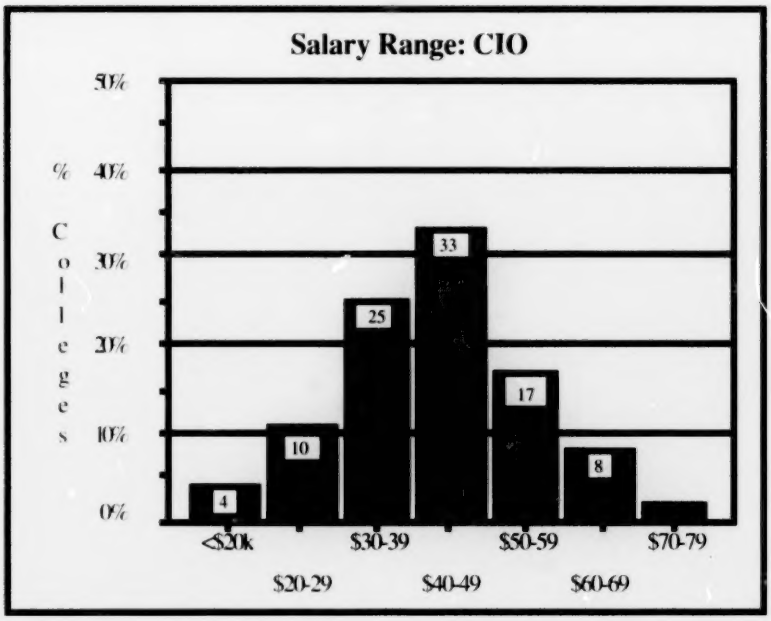


Salaries

Salaries for those responsible for information technologies vary across a fairly wide range among the responding colleges. On average, CIOs, on campuses with such positions, tend to receive the highest salaries. However, just twenty-eight percent receive salaries of fifty thousand dollars per year or greater, and fourteen percent receive salaries less than thirty thousand dollars per year.[8]

The modal (33%) salary range for CIO salaries is $40,000 - $49,000 per year. In contrast, $30,000 - $39,000 per year is the modal salary range for directors of administrative computing (34%), academic computing (35%), and libraries (44%). Of the three directors positions, the directors of academic computing are least likely to earn $40,000 per year or more. (Twenty-nine percent for directors of academic computing relative to 37% for directors of administrative computing and 33% for library directors.)

[8] Recall that some respondents reported that the person recognized as the CIO for their campuses was actually the vice president for academic affairs, finance, or other traditionally senior level administrator.


Salary Range: CIO
50%
40%
30%
20%
10%
0%
% Colleges
4
10
25
33
17
8
<$20k
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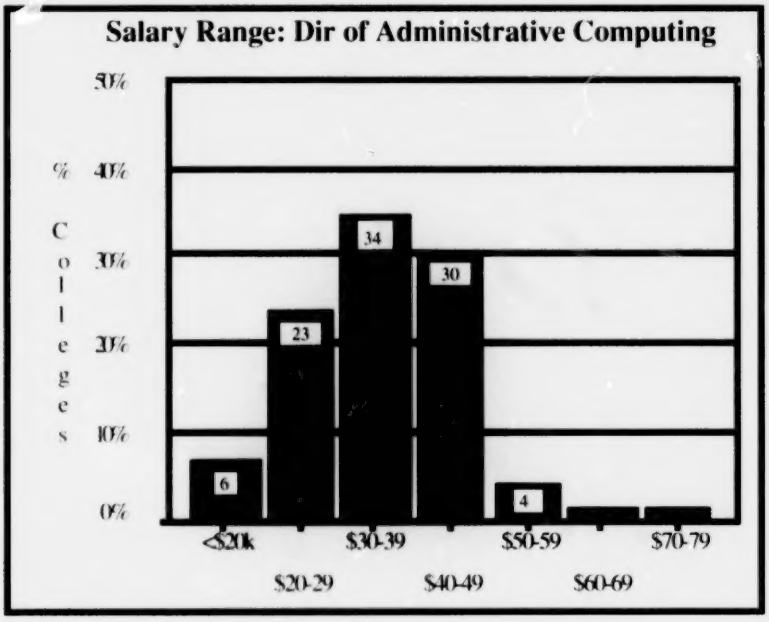
$40-49
$50-59
$60-69
$70-79


Salary Range: Dir of Administrative Computing
50%
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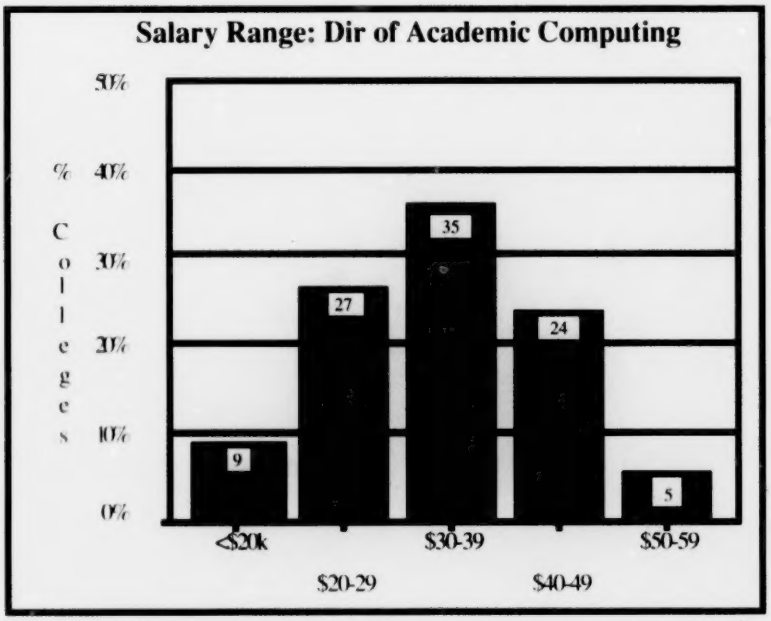
$40-49
$50-59
$60-69
$70-79


Salary Range: Dir of Academic Computing
% Colleges
50%
40%
30%
20%
10%
0%
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35
24
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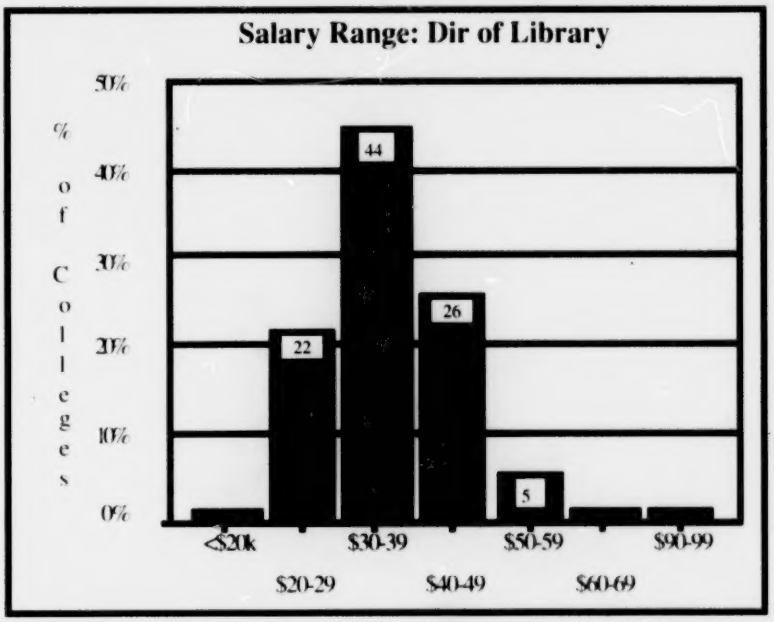
$20-29
$30-39
$40-49
$50-59


Salary Range: Dir of Library
% of Colleges
50%
40%
30%
20%
10%
0%
22
44
26
5
<$20k
$20-29
$30-39
$40-49
$50-59
$60-69
$90-99

We do not have comparative data for the responding colleges on salaries for other administrative positions. Therefore, it is impossible to determine the relative standing of these salaries compared to other administrators employed by responding colleges. However, it appears safe to conclude that administrators responsible for information technologies are modestly compensated and are, in all likelihood, in very demanding positions given the modest sizes of their staffs.

Given the wording of the questionnaire it is not possible to assess FTE support of an increasingly important function — design, implementation, and management of computer networks. Nor can we ascertain the average salary of those responsible for this function.

We know from substantial anecdotal evidence accumulated from the four Pittsburgh Workshops on Information Technologies that our members believe networking expertise is extremely important to their future, effective use of information technologies. Unfortunately, networking expertise is difficult to come by and relatively expensive. Equally unfortunate, poor planning or mistakes in implementation of a network can be very expensive and can limit effective use of information technologies for a decade or more. This often leads a college to turn to vendors for free advice which, in turn, can lead to vendor-specific solutions which are not necessarily in the best interest of the college. Alternatively, colleges may turn to independent consultants whose expertise often comes with a high price tag and whose advice may not be sensitive to the particular needs of relatively small colleges.

CIC recognizes the importance of networking expertise to its members and is beginning to address the issue in very concrete ways. In particular, the March 25-27, 1993 Pittsburgh Workshop on Information Technologies concentrated on campus networking and Internetworking issues. We will also be seeking means to incorporate the concept of shared access to networking expertise in subsequent proposals as this Information Technologies Project continues.

PART II: Access to Information Technologies

The CIC/CAUSE survey provides us with a wealth of information regarding access to information technologies on our member campuses. Our primary focus in this part of the report will be on access to information technologies for educational computing. However, we will have occasion to examine related areas.

Given the information available, it appears that CIC members are stretching their investments in technology and their relatively small staffs to create an environment in which students and faculty have fairly extensive access to information technologies. There is also fairly widespread use of some rather innovative technologies. However, we will also discover inherent limitations to the types of uses to which these technologies may be put in support of learning, teaching, scholarship, and community service.

We begin this part of the report with a limited comparative and historical analysis of CIC members' access to information technologies relative to other colleges and universities throughout the country. The information for this section comes from the College Board's annual survey of colleges and universities. We then focus on the information gleaned from the CIC/CAUSE survey.

CIC Institutions Compared to Other Colleges and Universities

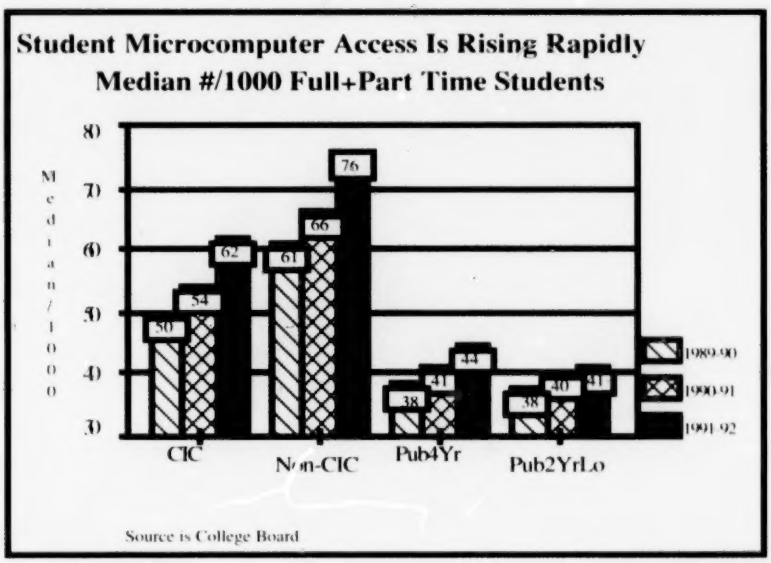
Each year the College Board surveys all of its college and university members to gather information relevant to the college choice and admissions processes. Recently, the College Board has asked a limited number of questions regarding the availability of information technologies on college and university campuses across the country. With these data we are able to make some historical comparisons of our members to other colleges and universities.[9]

[9] The following legend applies to the figures in this section:

CIC	CIC members, all of which are independent, four-year colleges and universities (13% of the nation's colleges and universities in 1991-92; 5% of all full-time undergraduates; 3% of part-time undergraduates)
Non-CIC	All other independent, four-year colleges and universities (32% of institutions; 20% of full-time students; 8% of part-time)
Pub4Yr	Public, four-year colleges and universities (21% of institutions; 57% of full-time students; 30% of part-time)
Pub2YrLo	Public, two-year, lower division colleges (25% of institutions; 16% of students; 58% of part-time)

Student Access to Microcomputers

There is a striking difference in access to information technologies between independent, four-year colleges and universities relative to public four-year and two-year institutions. Students attending CIC member colleges as well as non-member colleges have historically had significantly greater access to microcomputers, and the differences between the independent and public sectors is growing



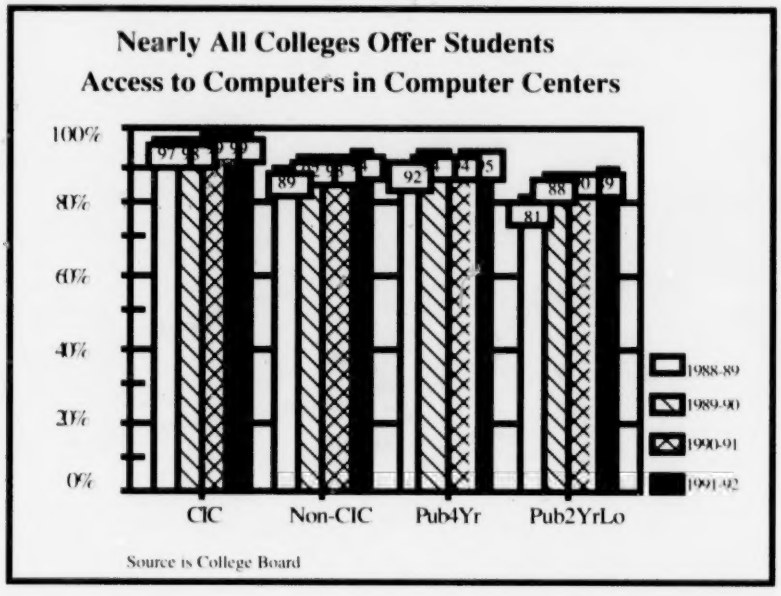
Within the independent sector there are significant differences between CIC members and non-members. While CIC colleges provide greater access to microcomputers than do public institutions, the same cannot be said relative to non-member independent colleges and universities. In 1989-90 CIC members provided (on average) eleven fewer microcomputers per thousand students than did non-members. In 1991-92 this difference had grown to fourteen microcomputers per thousand students.

On the one hand this difference in access to an important information technology may be cause for concern in an increasingly competitive market place for students. On the other hand, the average non-member college or university charged in excess of one thousand dollars more in tuition and fees in 1991-92 than did the average CIC member, so at least some difference in access is expected.

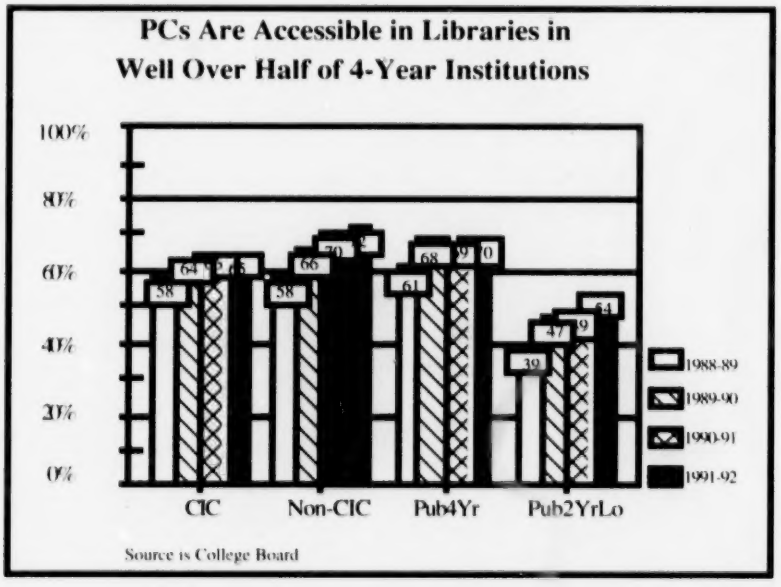
In 1991-92 at the typical CIC member college sixteen students shared a single microcomputer. Thirteen students shared a computer at non-member institutions; twenty-two students at public, four-year institutions; and twenty-four students shared a computer at the typical public two-year college. From the point of view of students who would like to use microcomputer tools extensively in their work, none of these ratios approximates an ideal of one student per microcomputer. In our own work, we have found that it is not necessary to achieve this ideal to create an environment in which students essentially have on-demand access to microcomputer for use as personal productivity tools. A ratio of five or six students per microcomputers seems to work rather well. Ratios above ten or so students per microcomputer, in contrast, seem to create obstacles to access which can limit their effectiveness as a means to enhance the learning process (as opposed to use as personal productivity tools). It can also create reluctance on the part of faculty to assume they may make assignments which require the use of computers.

This issue of how much access students have to information technologies is extremely important, and we will return to it throughout this part of the report. Suffice it to say at this point that CIC members compare reasonably well to non-

member independent colleges and universities and very well relative to public colleges and universities.
Students gain access to microcomputers in a number of areas on their campuses. A nearly ubiquitous location where students may use microcomputers is in the campus computer center, which essentially all colleges and universities in this country have had for a number of years.



Libraries are also places where students may go to use microcomputers. However, from the wording of the College Board's question, it is unclear the extent to which the purposes for which they may be used are restricted to library functions. The fact that approximately two-thirds or more of all four-year colleges and universities (and one-half of two-year colleges) provide access to microcomputers in their libraries, at the very least, bodes well for the emerging synergy among information technologies and information resources. And CIC member colleges compare quite favorably to their competitors in this important area.



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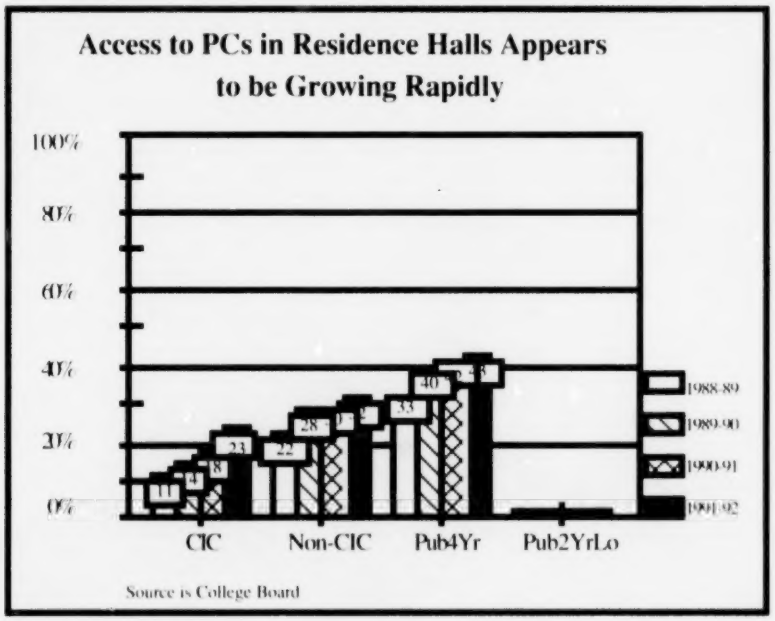
Another campus location to which students may turn for access to microcomputers is their residence halls. Although less than half of all colleges and universities provide this kind of access to microcomputers, the trends are clear. More and more independent and public colleges and universities are providing access to microcomputers in residence halls, and the growth rate among CIC members is the greatest of all three groups of four-year institutions. The percentage of members offering students access to computers in residence halls doubled during the period 1988-89 to 1991-92. The growth rate in this percentage for non-member independent colleges was forty-five percent and for public, four-year institutions it was thirty percent.



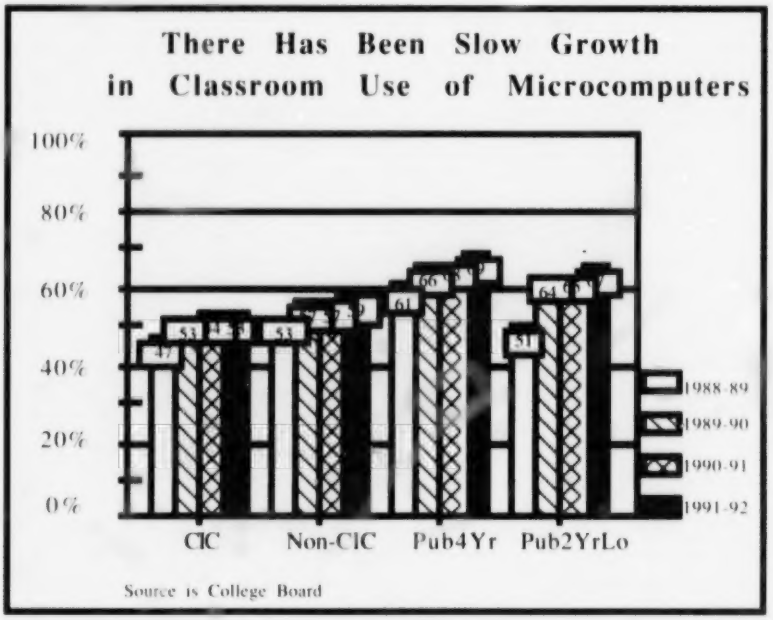
We should exercise some caution here because the actual percentage of institutions which provide substantial access to computers in residence halls is problematic to assess with these data. In the extreme, a single microcomputer in a single residence hall would qualify a college or university to answer yes to this College Board question. Therefore, the larger the institution and/or the more residence halls a college or university has the more likely it will answer yes to this question. The public, four-year colleges and universities are by far the largest four-year institutions in the country on average. They are followed by non-CIC independent colleges and universities and, finally, CIC members. The differences in residence hall access follow this expected trend, so it is very difficult to assess whether there is a real difference in access or whether the differences are simply due to differences in size.

The most important observation remains the *trend in access* to computers in residence halls. Like access to computers in libraries, this trend reflects a move toward placing computers in locations where certain kinds of activities would normally take place (e.g., studying, library research) rather than requiring students to go to a designated area on campus to gain access to information technologies. Given the previously described caveat, CIC members seem to compare well in this apparent move to make access to information technologies more convenient for students.

Microcomputers in the Classroom

It is also difficult to assess from the College Board's data the extent to which microcomputers are used in classrooms across the country. On the one hand, it appears that faculty at public institutions are more likely to employ microcomputers in the classroom than faculty at independent colleges and universities. On the other hand, public institutions are much larger than independent institutions. So, the likelihood that at least one faculty member at a larger institution uses computers in the classroom may be higher simply due to institutional size. And, just as with computers in residence halls, the apparent level of classroom use follows well the differences in institutional size across the four groups of colleges and universities.

A more important observation based upon these data is that the *growth* in the percentage of institutions in which at least one faculty member uses microcomputers in the classroom has been *relatively slow* over the past four years and has not kept pace with the growth in access to information technologies outside the classroom. This is consistent with the almost ubiquitous observation that relatively little progress has been made in integrating information technologies with our curricula.



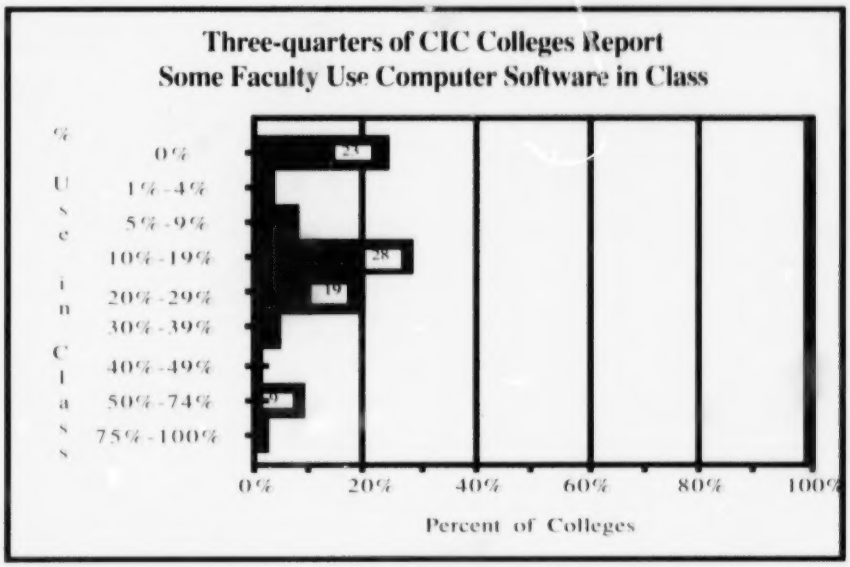
A Focus on CIC Colleges and Universities

The overall conclusions from the College Board data are: 1) CIC members fare well in comparison to their competitors, and 2) the trends are all toward more availability in more places to more computers. Putting the pieces together, the data suggest that computers as tools (word processors, spreadsheets, graphics packages, etc.) are now more accessible to students than they have been in the past and that accessibility will continue to improve over time. The data do not indicate, however, that there have been significant strides in creating a strong tie between the ends of learning and the means of information technologies. We may be making too strong a point with the latter observation. However, we believe the more detailed information from the CIC/CAUSE survey add further credence to it.

Classroom Use Revisited

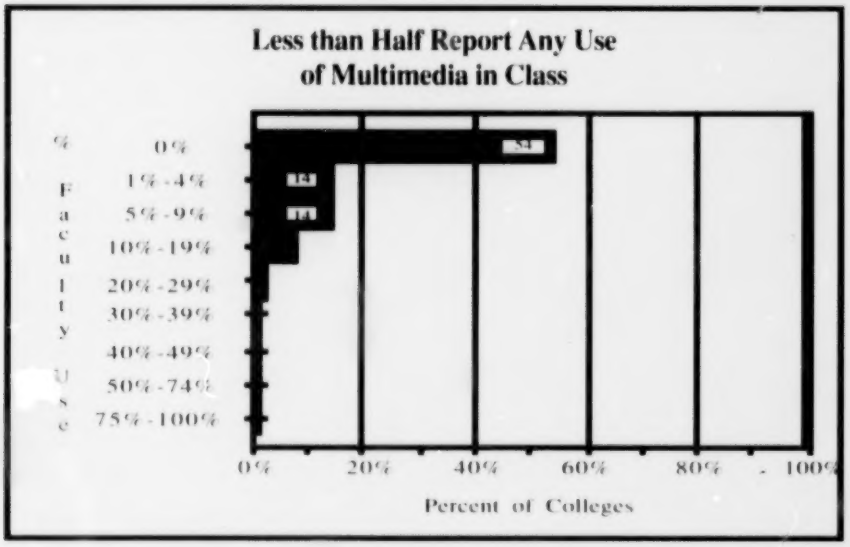
Three-quarters of our survey respondents indicated that at least some of their faculty used computer software in their classrooms[10], while approximately one-quarter indicated no use of computers in classrooms. Nearly half the respondents indicated between ten and twenty-nine percent of their faculty used computers in class, and about twelve percent indicated more than half their faculty did.

One's interpretation of this "glass is half full versus half empty" phenomenon depends upon one's view of computer software. From our perspective, until quite recently there has been little software (beyond personal productivity tools) available which actually enhances the learning process across the liberal arts disciplines. For the most part, about the most a faculty member could expect from computers in the classroom was to use them as presentation devices. However, with the advent of significantly more powerful processors, new windowing environments for IBM-compatibles, multimedia capabilities, more affordable UNIX workstations, and the networking of computers across campuses the climate for integrating computing tools with learning is improving significantly. The utility of these new tools will take time to evaluate and it will be longer still before they are available in significant numbers on our campuses.



For example, our respondents report very few of their faculty use multimedia in their classrooms. As we will see in subsequent figures, there is little opportunity on most CIC campuses to use this emerging technology because most campuses do not have significant numbers of computers, if any, capable of handling multimedia information effectively. There is also quite a bit of industry hype surrounding this new technology "in search of a demand." Finally, standards are only now emerging which will allow wider access to multimedia technology.

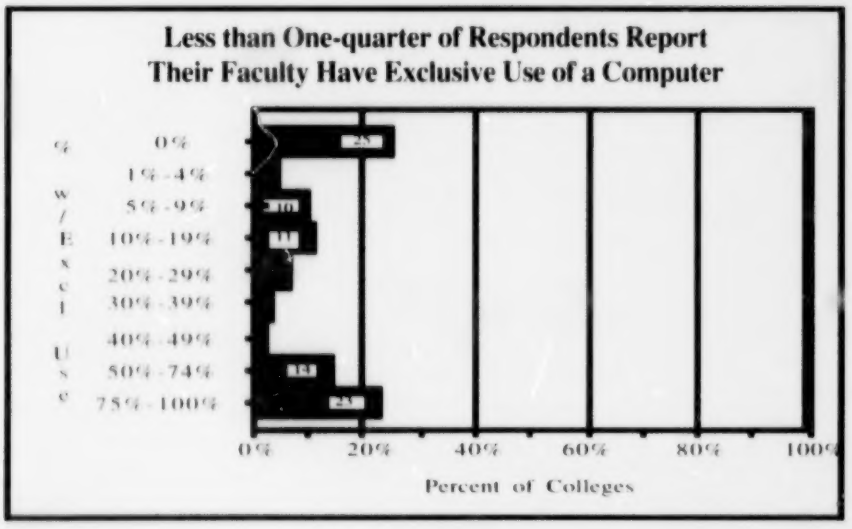
[10] This is higher than the figure reported in the College Board data. The differences are likely to result from a mix of the following factors: 1) the College Board data cover all CIC colleges, not just the respondents to the CIC/CAUSE survey; 2) the survey was taken a year after the latest available College Board data; and 3) computer center directors rather than admissions officers responded to the CIC/CAUSE survey.



Faculty Access

If our significant investments in information technologies are going to have a significant impact on learning beyond that of providing important tools such as word processors and spreadsheets to our students, then it is our faculty who will be the ones who must create the necessary integration between learning and information technologies. Two of the necessary (but not necessarily sufficient) criteria for success in this regard are the availability of time to explore information technologies and ready access to these technologies. It is a well known truism that one of the scarcest resources on any college campus is time. So, ready access is of even greater importance than it might otherwise be.

The data in the next figure do not suggest that conditions are conducive to in-depth faculty exploration of information technologies on most of our members' campuses. Only twenty-three percent of the survey respondents report that three-quarters or more of their faculties have exclusive access to a microcomputer or workstation. This proportion is nearly equaled by the number of campuses reporting that none of their faculty have exclusive access to an institutionally owned computer.



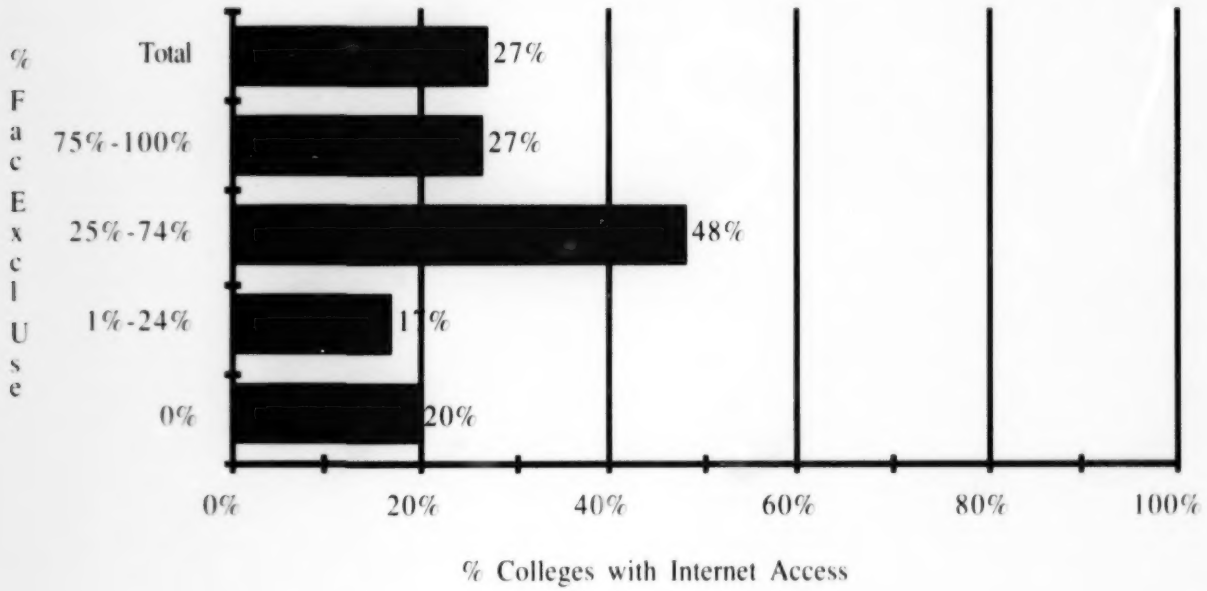
Access to the Nation's Internet

Faculty access to microcomputer technologies is a critical issue in an another area that is rapidly gaining in importance in higher education. We referred in Part I to emerging organizational and computing ideals and to the notion of groups of individuals sharing information and ideas across networks of computers located on individuals' desk tops. This type of computing use is spreading rapidly throughout the corporate community and among colleges and universities. In addition, corporations and educational institutions are connecting to wide area networks, particularly the Internet, in exponentially growing numbers. Internet connections, in turn, provide students and faculty with access to colleagues around the world and vast quantities of information of significant benefit to liberal arts colleges.

The benefits of campus-wide networking and the benefits of connecting to the Internet cannot be fully reaped unless our faculty have computers on their desk tops connected to these networks. These topics are treated extensively in the second report in this series. So, we will discuss the topic only briefly here.

Twenty-seven percent of our survey respondents indicated that their campuses were connected to the nation's Internet. One might have assumed that the greater the proportion of a campus' faculty which had exclusive access to an institutionally owned computer, the greater would be the likelihood that the campus was connected to the Internet. In fact, as the following figure illustrates, this is not the case — only one group stands out as having greater than the average connectivity to the Internet. Forty-eight percent of campuses on which twenty-five to seventy-four percent of their faculty have exclusive use of a college computer were connected to the Internet; the remainder are much less likely to be connected.

No Systematic Relationship between Internet Access and % of Faculty with Exclusive Access to a Computer

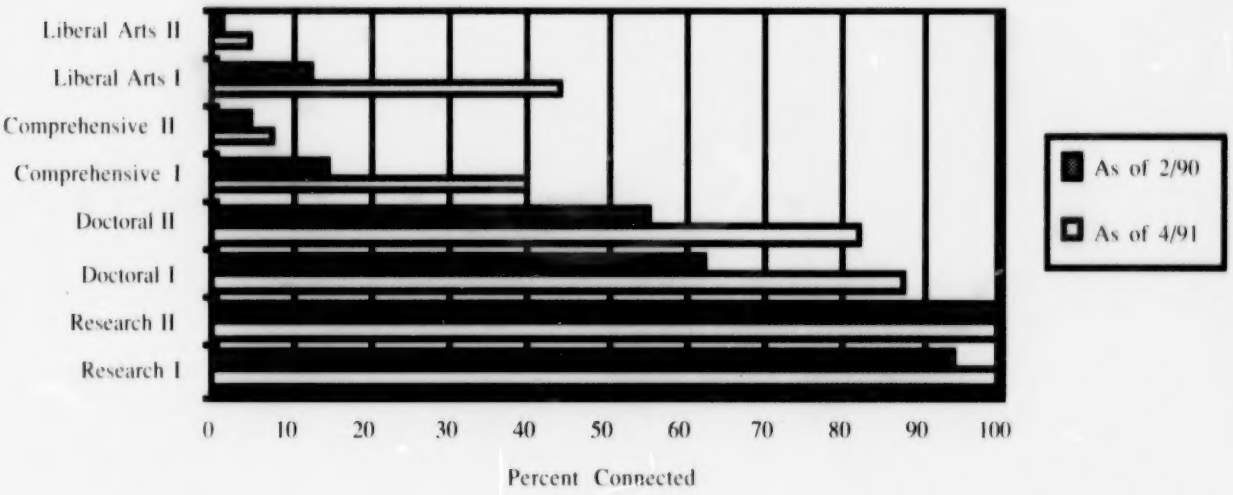


From our perspective, this is an opportunity. We believe that colleges are much better off gaining an understanding of what is available on the Internet and exploring means to create widespread campus access to these resources before they make critically important campus networking and hardware/software acquisition decisions. The technical issues of providing desk top access to Internet resources are nontrivial, and it is much better to experiment with them before

network design decisions are taken than to deal with them afterwards. Equally important, determining what resources are available free or at low cost on the Internet may lead colleges to decide to reallocate resources they were intending to use to purchase these resources locally. The data suggest, then, that the approximately one-quarter of our members who are already connected to the Internet appear to be in good positions to integrate Internet access into their information technologies planning.

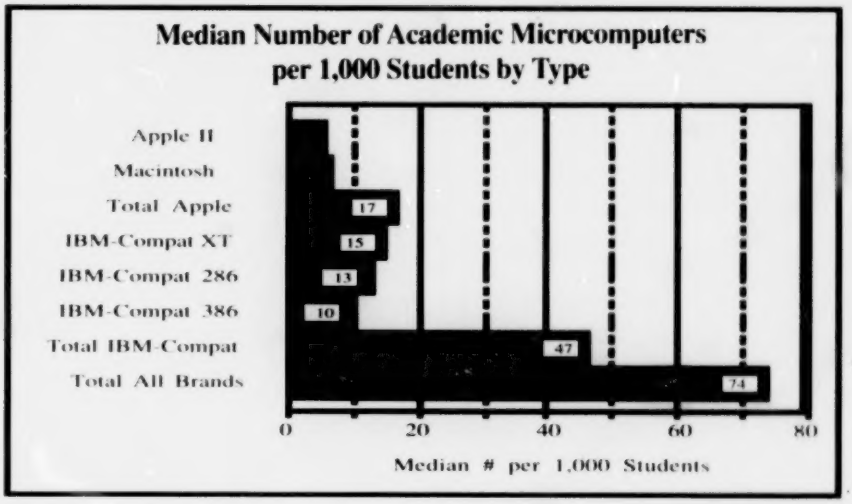
On the other hand, three-quarters of our respondents are not yet connected to the Internet. Many of the nation's colleges and universities now provide access to the Internet routinely for their faculty, students, administrators, and staff. As we explain in our companion paper on the Internet, the competitive disadvantage of not being connected to the Internet is increasing rapidly in the market place for both students and faculty. Most new faculty now take Internet access for granted because it was an integral part of their graduate student experience. And a rapidly growing number of high school graduates are coming to us with Internet experience. In fact over one thousand high schools are now connected to the Internet and thousands more are connected either indirectly or to similar wide area networks within their states.

Connection to the Nation's Internet Is Rapidly Becoming Necessary to Stay Competitive

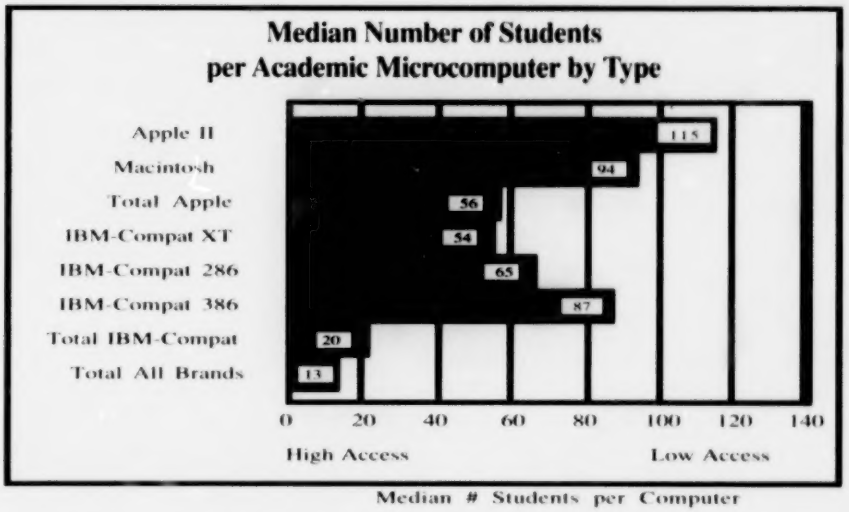


If your college is not yet connected to the Internet, or you are just beginning to explore the Internet, or your campus is not yet networked, we encourage you to read the forthcoming paper on the Internet, attend the next Pittsburgh Information Technologies Workshop, and to begin planning now to connect to this valuable resource as quickly as is prudent for your institution. This is an exciting time for education as the nation begins seriously to reap the advantages of networked access to vast information and technological resources directly beneficial to liberal arts colleges and other educational institutions. As part of the CIC Information Technologies project we will devote significant attention to assisting our members as they seek to take advantage of these resources.

Apple Computer, Inc. and IBM-compatible computers have an overwhelming presence on our campuses. As the following figures illustrate, students and faculty have access to a wide range of microcomputers in fairly large numbers.[11] The median number of microcomputers on our respondents' campuses per one thousand students is seventy-four. There are seventeen Apple computers (either Apple IIs or Macintoshes) per one thousand students, and forty-seven IBM-compatible computers per one thousand students.



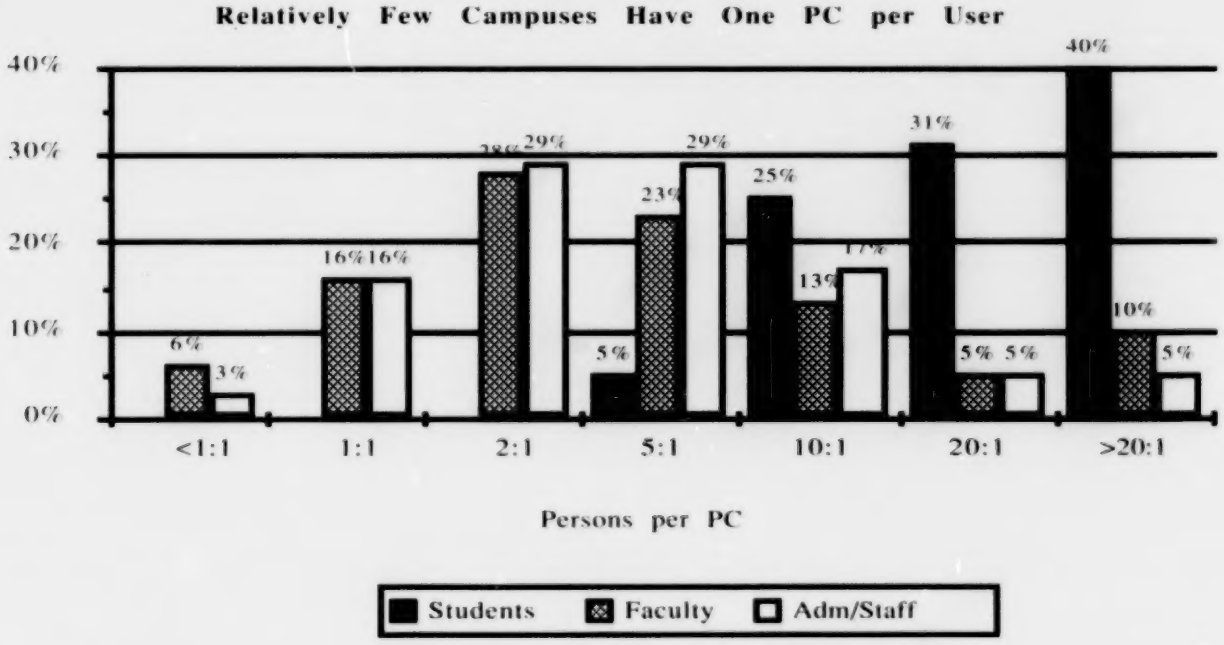
In terms of access these figures translate into a median of thirteen students per microcomputer of all types on our respondents' campuses. There are twenty students per IBM-compatible computer, and fifty-six students per Apple computer.



[11] We normed the data to account for institutional size and to provide a means for readers to compare their institutions easily to the median for the responding institutions. From the point of view of access, however, the median number of students per microcomputer is a better measure. See the following figure.

The data on numbers of students per computer are somewhat inflated because the questionnaire did not distinguish between academic computers devoted to student use as opposed to faculty use. The 1991-92 College Board data yielded a median of sixty-two computers per one thousand students for all CIC campuses (not just the respondents), and the College Board question did specify computers available for student use. This translates into a median of sixteen students per microcomputer on CIC campuses.

The following figure from the CIC/CAUSE survey shows that on forty percent of the respondents' campuses the ratio of students to microcomputers is over twenty to one. Thirty-one percent had a ratio of twenty students per microcomputer, twenty-five percent had a ratio of ten to one, and five percent had a ratio of five to one. One respondent indicated a ratio of one student per microcomputer.

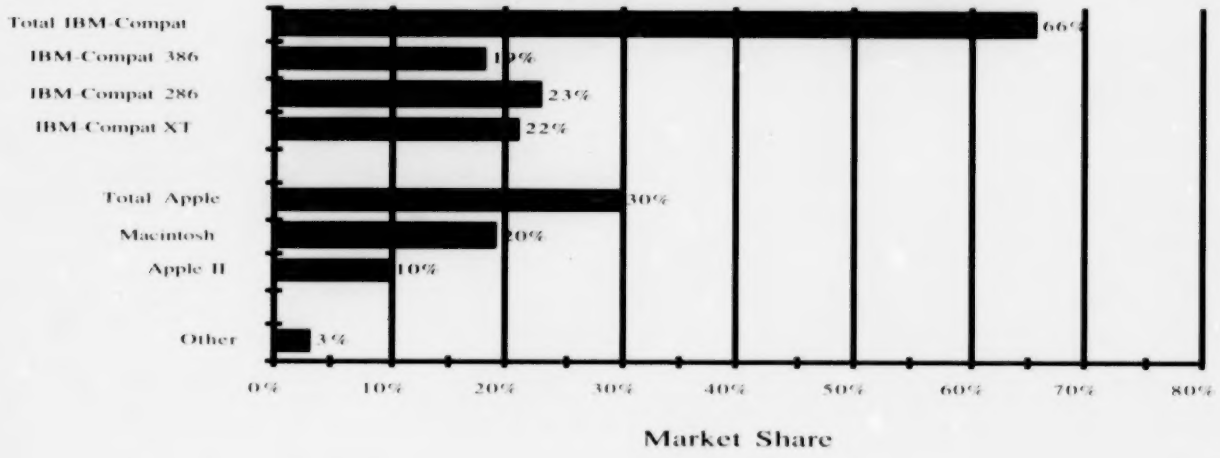


From the perspective of using computers as personal productivity tools, these ratios for student access are high but not unreasonably so for most students to be able to use spreadsheets, word processors, and other tools more or less when they need them. However, it is safe to say that on most of the respondents' campuses computing could not be available on demand for all students to use these tools whenever they chose, i.e., students cannot take access to computing tools for granted.

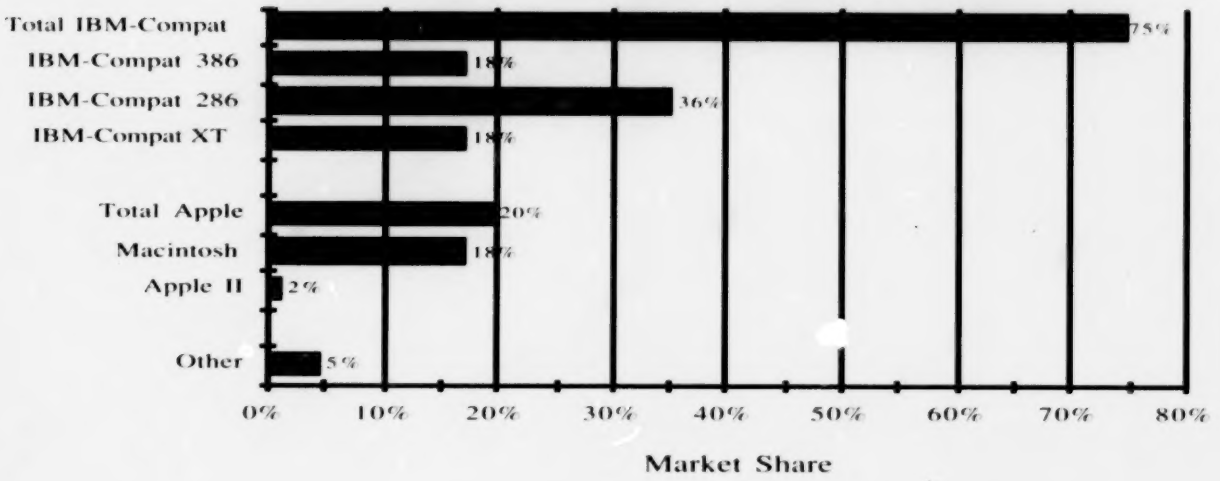
The picture is a great deal different for faculty and administrators. Approximately twenty percent of the respondents indicate that each of their faculty members and administrators have exclusive use of a computer. About three-fourths of the respondents indicated that the ratio of faculty and administrators to computers is no worse than five to one. There is a significant amount of sharing taking place, but there also appears to be a fairly large presence of computing in faculty and administrative areas.

The following two figures clearly demonstrate that IBM-compatibles dominate both academic and administrative use of microcomputers. IBM-compatibles account for sixty-six percent of the microcomputers used for academic purposes and seventy-five percent of those used for administrative purposes. Apple microcomputers account for thirty percent of the academic computers and twenty percent of the administrative microcomputers.[12]

IBM-Compatibles Dominate Academic Microcomputers



IBM-Compatibles Dominate Administrative Microcomputers

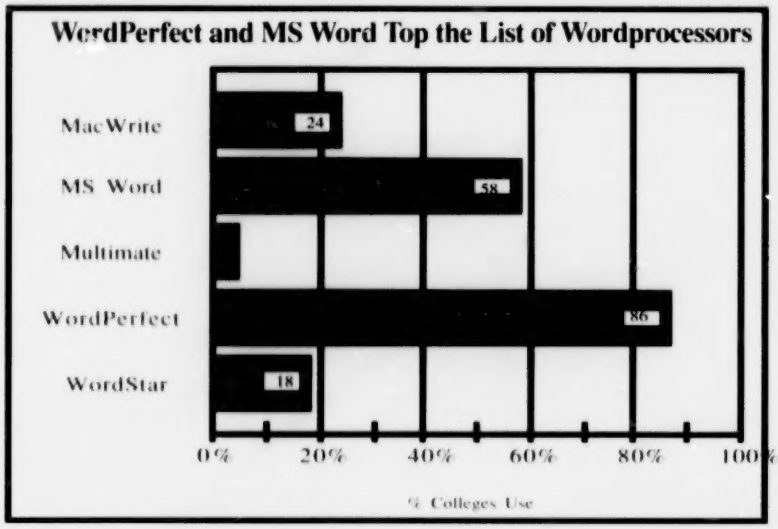


[12] Many of our campuses also use minicomputers (e.g. IBM AS400, Digital Vax, etc.) for academic and administrative purposes. The form of the data collected on the questionnaire made this information difficult to work with for this paper. Therefore, we will provide information about the use of minicomputers in a subsequent report.

These figures reveal another important message. There is essentially no presence in either academic or administrative computing of high-end IBM-compatibles (486 based), Apple Quadras, or UNIX workstations.[13] Over half the academic computers present on the respondents' campuses are incapable of running user friendly and powerful graphical user interfaces such as the Macintosh interface or Microsoft Windows for IBM-compatibles. The same proportion are incapable of running emerging multimedia applications. Among the IBM-compatibles, nineteen percent are 386-based microcomputers. These machines, while they are capable of running Windows, do so slowly and often with considerable limitations. Perhaps most important among the latter is the lack of true multi-tasking (running more than one application simultaneously).[14]

Access to Software Tools

The diversity of personal productivity tools used by the responding campuses reflects the diversity of their hardware environments and industry trends. WordPerfect is the dominant word processor used by eighty-six percent of the responding campuses followed by Microsoft Word (58%) and MacWrite (24%).



Lotus 1-2-3 is the dominant spreadsheet used by eighty-five percent of the responding campuses. Next comes Microsoft Excel (45%) and Borland's Quattro (34%).

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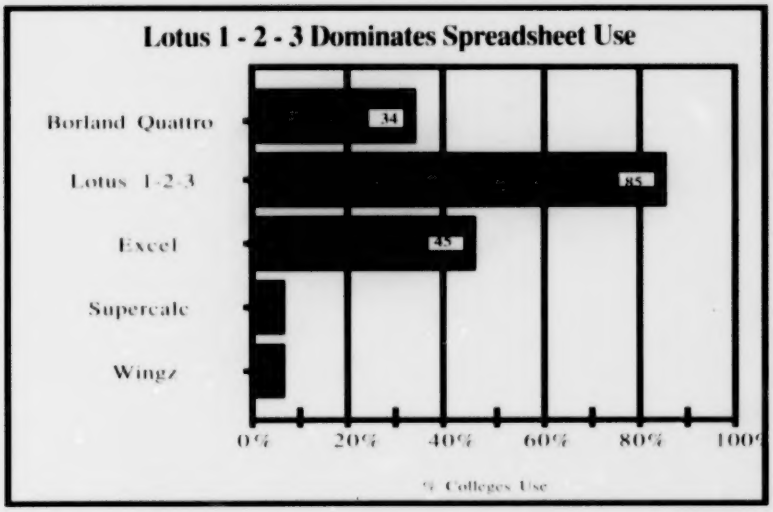
[13] A handful of respondents indicated the presence of a few of these types of machines on their campuses. They are included in the "Other" category in both figures.

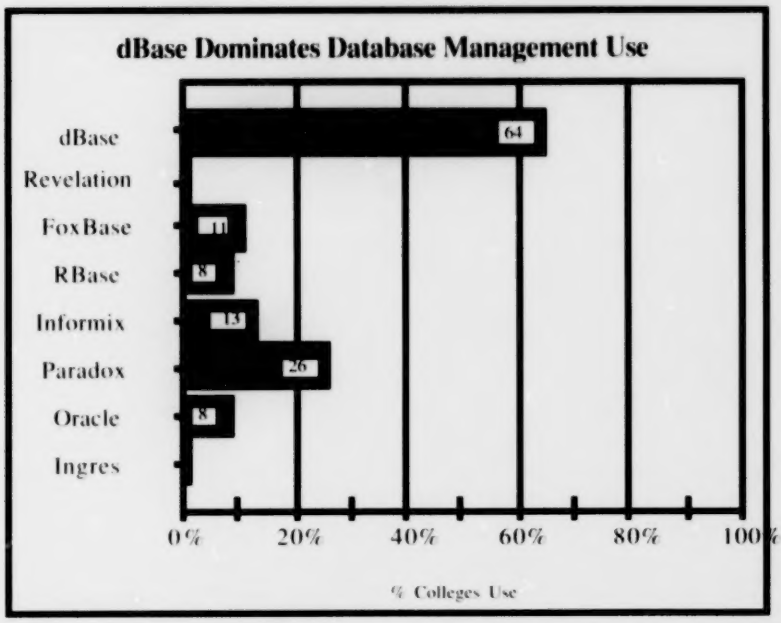
Apple Quadras are Apple's high-end computers which use the Motorola 68030 or 68040 chip as their central processing units, or CPUs. Combined with the System 7 operating system, these machines are capable of running very sophisticated yet user-friendly applications.

Intel's series of CPUs begins with 8088 and 8086 chips used in older IBM-compatible computers. These are low-end machines which may be used for very basic word processing, spreadsheet and other applications. Intel introduced a new series of CPUs with its 80286 chip. While quite a bit more powerful than older chips it also is not capable of running much more than basic productivity software effectively. The 80386 chip, a much more powerful CPU, can provide a platform on which to run some of today's more powerful applications. However, most of the newer versions of powerful software, including multimedia, run only marginally well on this chip. For most of the newer applications, the 80486 is really the CPU of choice. See below for further discussion of this issue.

[14] We have tried to avoid the use of technical terms throughout this report. However, there are occasions where it is necessary to use the jargon of the computer world. The forthcoming report on teaching, learning, and information technologies will translate this jargon into terms which are meaningful to educators.



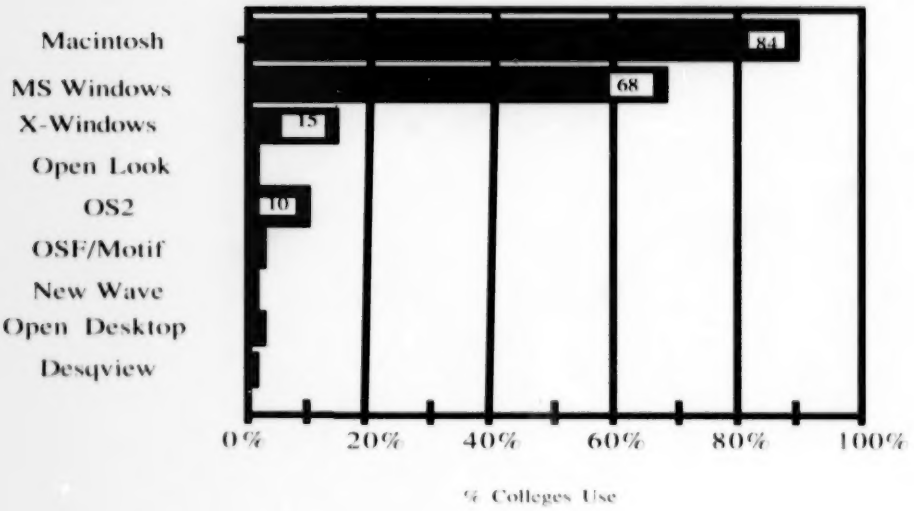
The respondents report using dBase on more campuses than any other database management package (64%). This is followed by Paradox (26%) and then a number of other packages in the eight to thirteen percent range.



A more generic category of software is the category of graphical user interfaces or GUIs. A GUI is a product that makes a computer much easier to use, particularly for those who care more about getting their work done than about computers, because it allows you to use a mouse and fairly intuitive menus and icons to accomplish tasks with a computer. Also, applications which run under a particular GUI share common features (e.g., menu structures and means to access other programs), so learning to use a new application once one application is mastered is much easier than in a command-driven environment.

The Apple Macintosh pioneered GUIs on personal computers and it is specially designed to handle the increased computing resources needed to refresh a computer screen rapidly while using a graphical user interface.[15] Eighty-four percent of the responding campuses own at least one Macintosh computer for academic use and therefore have access to this graphical user interface.

There is Little Use of Windowing Environments Beyond Microsoft Windows and Macintosh



The next most dominant GUI is Microsoft's Windows. Unlike the Macintosh, however, IBM-compatible computers were not originally designed to work with graphical user interfaces. So, the drain on system resources which Windows creates is a problem which plagues many of it users, particularly those who use it on 386-based as opposed to 486-based Intel or compatible central processing units.

A recommended minimum configuration to run Windows 3.1 with a reasonable number of productivity tools is an 80486 processor with a math coprocessor (i.e., the DX as opposed to the SX version of the chip) and four megabytes of random access memory, or RAM.[16] However, even with four megabytes of RAM, some important applications will not function well or at all. For example, a new breed of software called symbolic manipulation programs (e.g., Mathematica, Matlab) is transforming the way mathematics may be used and learned from high school to advanced research. These programs run best with large amounts of RAM. Multimedia applications, particularly those that use full-motion video, also run best with large amounts of RAM.

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[15] A computer screen is made up of tiny color (or black and white) dots called pixels. When using a character-based terminal only a few of these pixels need to be updated because most of the screen is blank with just the characters appearing on them. In contrast, a GUI uses all the pixels on a screen simultaneously to give the user the impression that the screen is "painted" with menus, icons, and other graphic objects, in addition to the numbers and letters that would appear on a character-based screen. Since each of these pixels must be controlled by the computer, GUI-based applications require a significant amount of computing resources simply to present information on the computer's screen.

[16] RAM provides the CPU with a place to efficiently store the code for applications such as wordprocessors and to hold data such as text, graphics, or numbers while the CPU is processing it. If a CPU has too little RAM then it must frequently go to the computer's hard disk (the permanent location for the computer's data) to get information. This can cause very significant degradation in performance, and, in the extreme, cause the computer to stop functioning.

Microsoft Windows brings the ease-of-use associated with graphical user interfaces to IBM-compatible microcomputers. However, since these computers were not designed for GUIs, users must exercise great care in configuring their systems so they may actually be used effectively with the software that is being written to take advantage of this graphical user interface.

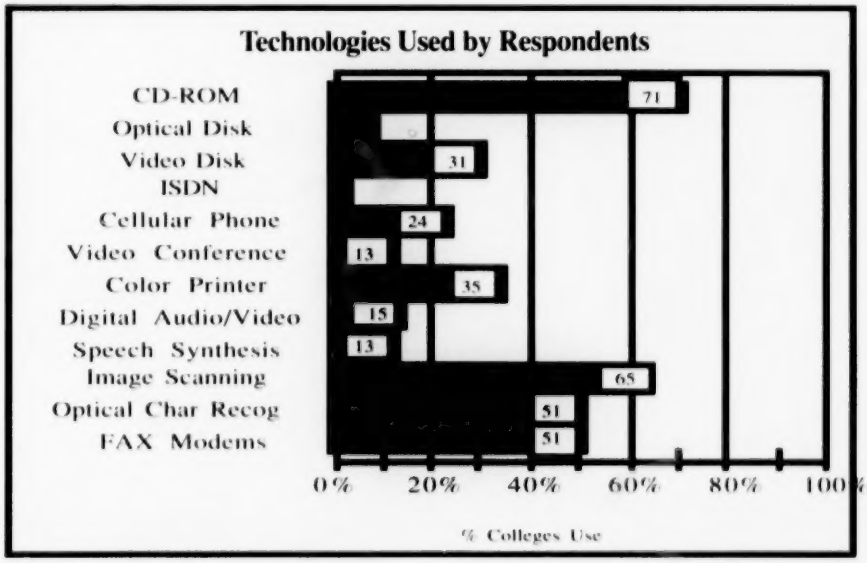
X-Windows is one of the GUIs which has been developed for the UNIX workstation market. Versions of it may also be used on microcomputers if they are connected to a UNIX workstation. There is little presence of UNIX workstations on the respondents' campuses, so it is not surprising to find little use of X-Windows.

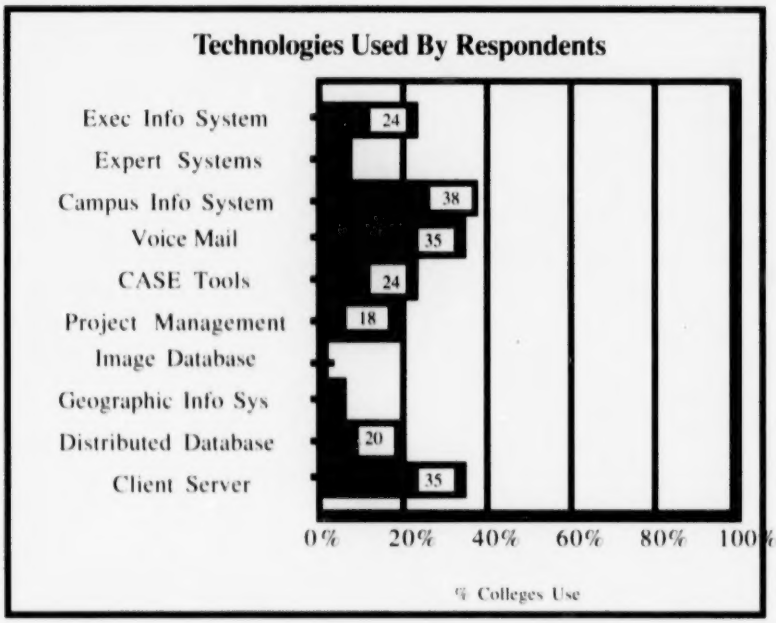
OS/2 is IBM's entry into the graphical user interface market. At one time IBM and Microsoft had a strong collaborative agreement centered on the development of OS/2. However, the two corporations split a while ago once Microsoft decided to push its Windows GUI. Since that time, Microsoft has captured a huge portion of the IBM-compatible GUI market with OS/2 a distant second.

As we mentioned in our acknowledgments, the CAUSE questionnaire is an exhaustive instrument which covers a great deal of ground. We will not be able to present all of the findings from it in this report. However, there are a number of other areas which relate to access to information technologies which we would like to present.

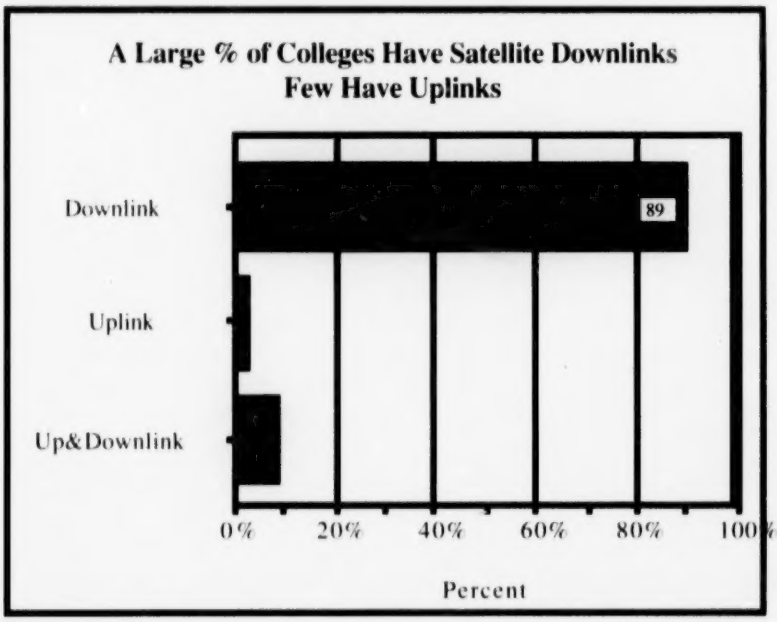
Innovative Technologies

The following two figures clearly demonstrate that CIC member colleges are using a large variety of innovative information technologies from CD-ROM technology to video conferencing to image scanning and optical character recognition. With the exceptions of CD-ROM, Fax modems, image scanning, and optical character recognition, none of these technologies are used by a majority of the respondents colleges. However, the diversity of new technologies in use is quite large and clearly demonstrates that member colleges are, at the least, experimenting with new technologies.





A very large percentage of the respondents also indicate use of satellite communications. Eighty-nine percent report at least satellite downlink capabilities, and approximately ten percent have uplink capabilities.

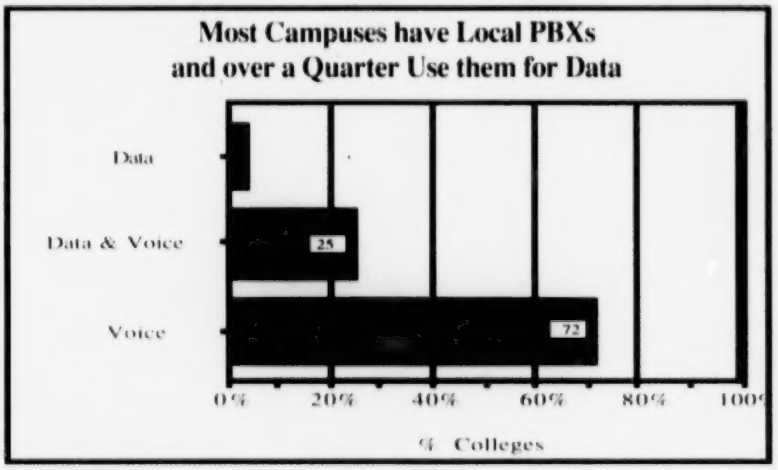


Campus Networking

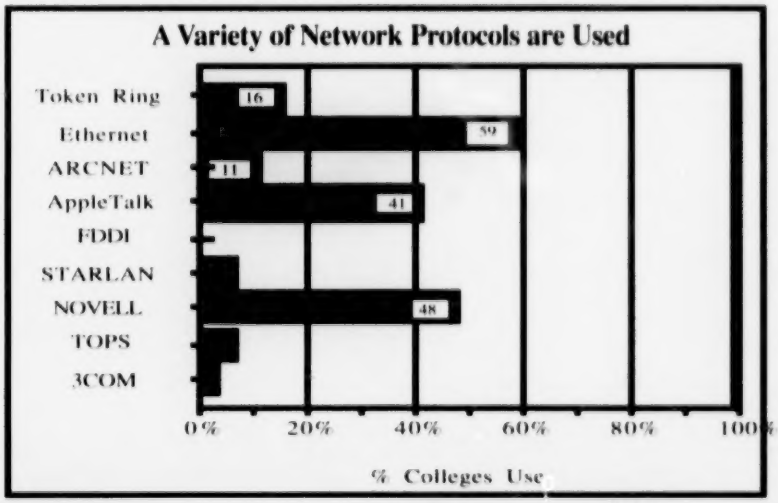
This is one of the most important areas of interest among CIC members as is clearly evidenced by the voluminous anecdotal data we have accumulated during the past four Pittsburgh Information Technologies workshops and other collaborative meetings. Unfortunately, the CAUSE questionnaire does not address this issue in a way which allows us to get a good grip on the extent to which local area networks, campus-wide networks, and connection to wide area networks such as the Internet are present on our member campuses.

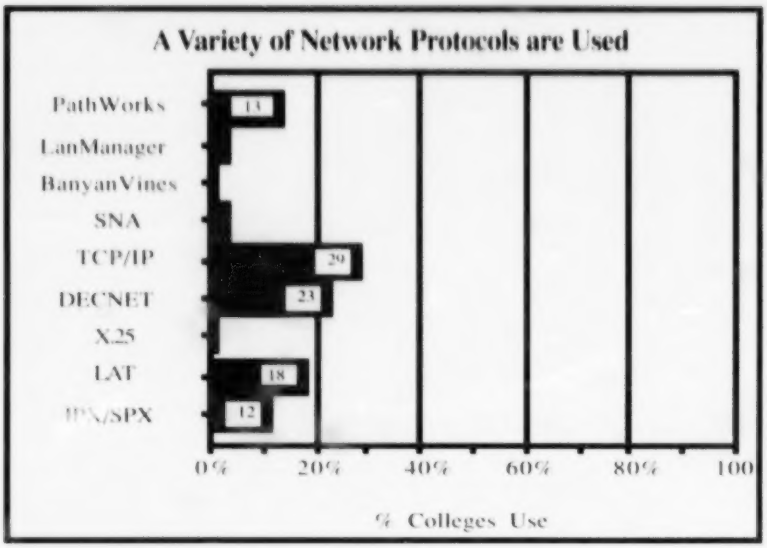
From earlier evidence presented in this report we know that on most campuses faculty members do not have access to a campus-wide network from their desktop. We also know that approximately a quarter of the respondents indicated their campuses were connected to the Internet.

Seventy-two percent of the respondents indicated their campuses owned their own PBX switch for voice communications. Twenty-five percent use PBX switches for both data and voice communications, and approximately five percent use a PBX switch for data communications only.



The questionnaire asked respondents to identify the network protocols used on their campuses. Given the nature of this aspect of computing it is not surprising to discover great diversity in the responses to this question. Among the proprietary network products, Novell and Apple have the dominant presence (48% and 41% respectively). Fifty-nine percent of the respondents indicated their campuses used the ethernet standard. Only sixteen percent use token ring.





Computer networks are a central requirement for moving toward the emerging organization/computer models described at the beginning of this report. Without effective, easy-to-use, reliable computer networks it is simply impossible to implement a model of collaborative work supported by distributed information technologies. As we write, the area of networking is going through a major period of transition which is coupled with significant changes in computing technologies. We will illustrate this issue by focusing on the emergence of multimedia technology which incorporates full-motion video.

Apple Computer recently released a software technology, called Quicktime, which allows people using no more than a mouse and their Macintosh computers to integrate full-motion video into their word processing documents, presentation packages, spreadsheets, and application development tools such as Hypercard. Initially introduced at fifteen frames per second it is now available at thirty frames per second, the minimum needed for VCR-quality video. Apple provides this software with their operating systems, i.e., it is essentially free. Other vendors, in particular Microsoft, are right on Apple's heels with their own versions of point-and-click video tools for IBM-compatible microcomputers, and Apple is releasing Quicktime for Windows so it will run on IBM-compatible machines.

Video imagery takes a vast amount of disk storage for even short, full-motion video sequences. A ten-minute video clip would easily consume the entire hard drive of most microcomputers. What Quicktime does is "compress" the video data using special mathematical algorithms, so it consumes less space on a hard disk. Then it decompresses it when you are ready to view it. The problem is that, even with the most efficient compression techniques, full-motion video still consumes vast quantities of disk space.

The point of this example is that using an extremely user friendly innovation such as Quicktime (which even grade-school children easily learn to use) puts incredible demands on computer networks because it makes no sense to repeatedly store the same video information on each user's hard drive. It is much more efficient to store the information in one place and then gain access to it via a network. The problem is that today's computer networks cannot handle the demands on them in these situations. So, the network industry is scrambling to come up with solutions which will provide the capability to move full-motion video, CD-quality audio and high-resolution graphic images across networks.[17]

[17] There are many other reasons why network companies are doing this. Among the most important is the ability of modern (relatively inexpensive) workstations to share objects of computer code and data across machines connected to a network to create very powerful applications for work group collaboration, scientific analysis, and many other areas important to learning and teaching in liberal arts colleges.

These problems are highly technical in nature. However, their solutions will have tremendous implications for the true integration of information technologies with teaching and learning. On most of our campuses we do not have access to the kind of technical expertise needed to assess the likely outcomes of these trends. Yet we must make decisions regarding networking our campuses.

How do we decide whether to install fiber optics in a campus backbone? Should we install conduit in new or renovated facilities which can handle fiber optics to the desk top? What kind of fiber should we install? Will FDDI, ATM, 100 meg ethernet, or some other protocol win out in the networking standards arena? What can we expect to pay five years from now for the electronics needed to handle new networking protocols? What difference do the varying answers to these technical questions have for us as liberal arts colleges?

In the past we could afford to make mistakes regarding information technologies because the implications of these technologies for teaching and learning were not particularly profound. For the most part, choosing one technology over another would not have a significant effect on learning or teaching. Only recently have technologies emerged which may be used to significantly improve learning and teaching on our campuses. Now our decisions regarding emerging networking technologies may significantly affect our competitive positions relative to institutions which employ them effectively.

A Competitive Advantage

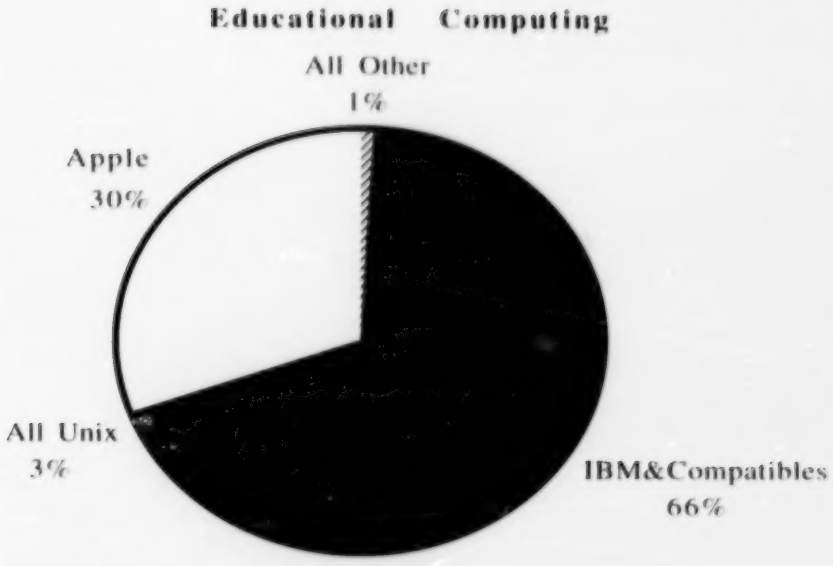
Although the data from the CAUSE survey are not conclusive, it appears that CIC member colleges have an advantage relative to other colleges and universities that have already made very large investments in networking technologies. Simply because the latter's investments are so large, it will be difficult for them to justify replacing older technology with emerging technology. In contrast, if our conclusion is correct, CIC member colleges, with astute planning, may make carefully targeted investments in the emerging technologies, reaping significant advantages for their students and faculty.

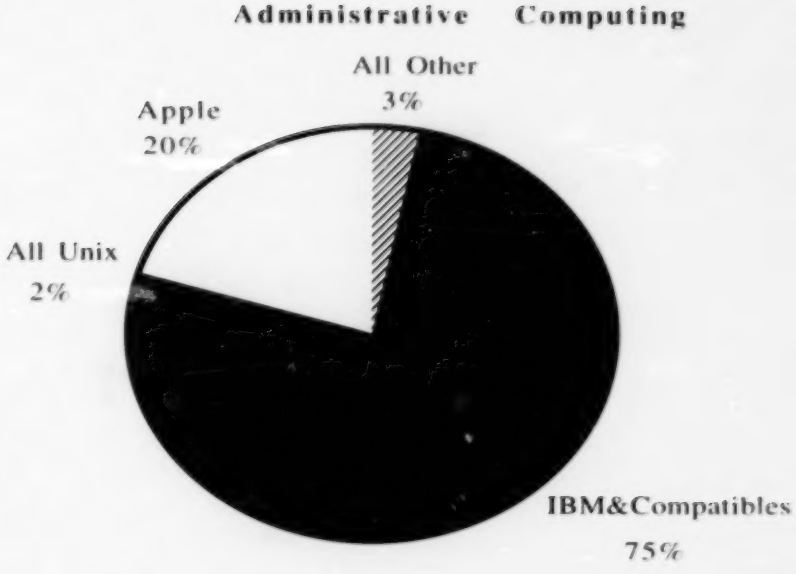
Something that would help us as we face these decisions is access to the expertise needed to make sense of these highly technical issues. One method for gaining access to expertise is to hire expert network engineers on our individual campuses. This is not financially feasible for most CIC members. Another is to hire outside consultants to assist us. This is a sensible approach. However, our experience suggests strongly that gaining a fairly good conceptual grasp of the emerging networking and related issues is a prerequisite to determining who a good consultant is and to directing consultants to focus on issues that are relevant to liberal arts colleges. A third approach, which is playing an increasing role in our Pittsburgh Information Technologies workshops, is to share our collective expertise. Finally, we can use our collective strength to gain access to expertise. This is an increasingly important theme for both the Pittsburgh workshops and the project on Information Technologies funded by the Buhl Foundation.

Vendor Relations

As we mentioned in a previous section, IBM-compatibles and Apple computers are the dominant types of computers on our members' campuses. IBM-compatibles represent between sixty-six percent and seventy-five percent of our educational and administrative computing markets, respectively, and seventy percent overall. The corresponding figures for Apple computers are thirty percent (educational), twenty percent (administrative), and twenty-seven percent overall. These figures are for all of the microcomputers owned by all of our respondents taken together.

On individual campuses, typically both types of computers have a presence. The median market share for Apple computers (for both academic and administrative use) is twenty-two percent. The twenty-fifth percentile market share is eight percent, and the seventy-fifth percentile market share is forty percent. For IBM-compatibles the median market share is seventy-four percent, the twenty-fifth percentile market share is fifty-six percent, and the seventy-fifth percentile market share is ninety-six percent.





In short, both collectively and individually CIC member campuses should be attractive to Apple Computer and to vendors of IBM-compatibles. The problem is that most individual CIC members do not have the buying power to be in strong negotiating positions with vendors.

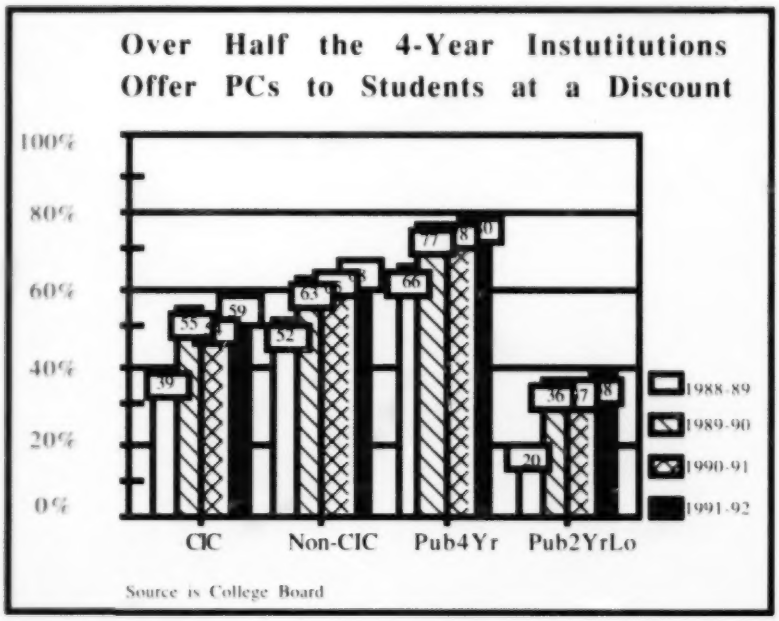
The seventy-fifth percentile for the number of IBM-compatibles owned by a responding college is 139. The seventy-fifth percentile for Apple computers owned by a responding college is 58. And the seventy-fifth percentile for the total number of microcomputers of all types owned by a responding college is 207. Thus the annual purchases for seventy-five percent of our members are in all likelihood simply not large enough to negotiate large discounts with computer vendors or to garner the attention of their most knowledgeable experts for advice.

This may be true for individual CIC members, but as a group, the same should not be said. Recall that thirty-eight percent of the members responded to the CAUSE questionnaire. These one hundred twenty members collectively own 17,481 microcomputers of all types. They own 4,635 Apple computers and 12,153 IBM-compatible computers. If we assume that the respondents are reasonably representative of the entire membership we may estimate the total installed base of microcomputers on CIC campuses as:

Estimated total number of microcomputers	45,640
Apple computers	12,100
IBM-compatibles	31,730

This is a very large installed base of microcomputers by anyone's standards. Adding weight to these numbers is the recent pattern of growth in the installed base which is suggested by the College Board data. These data suggest a rough estimate of approximately 10% annual growth in the number of microcomputers installed on CIC campuses. This translates into a rough estimate of aggregate purchasing power in the range of 4,500 total microcomputers, 1,200 Apple computers, and 3,100 IBM-compatibles per year. But these figures do not include computers purchased by students, faculty, and staff at CIC member colleges.

As the following figure indicates, over half of CIC members offer their students discounts on purchases of microcomputers. This suggests that there is already a fair amount of activity in this area.



There were approximately 400,000 students attending CIC colleges in 1991-92. Using this figure as an estimate of an annual base, if only 5% of these students were to purchase a computer through their college each year, this would represent a combined purchasing power of 20,000 microcomputers annually. When added to estimated annual purchases by their colleges, we believe a combined purchasing power of 25,000 microcomputers annually is conservative.

To be even more conservative, let us assume that our annual purchasing power estimate is off by 50% and only 50% of CIC members were to participate in a joint discount program. The estimate of purchasing power under these very conservative assumptions is approximately 6,250 microcomputers per year. This is more than adequate to enter into very successful agreements with hardware and software vendors.

Evidence for this is the success that CLAC has had in this arena. These fifty, small liberal arts colleges have been successful in negotiating attractive discount agreements with several major hardware and software manufacturers. And CIC more than makes up in its numbers the greater revenue per college available to CLAC members.

The computer industry is going through a wrenching period of transition as the major manufacturers engage in a price war that has already led to fifty percent reductions in prices from a year ago on many brands and models. Manufacturers are actively seeking ways to establish long-term partnerships with their better customers — partnerships which lead to better pricing for the latter and greater stability for the former. But price is not the primary issue. Through cooperation and effective planning CIC members collectively may gain access to heretofore unavailable or overly expensive expertise — from vendors and from independent experts. As the Information Technologies Project proceeds, we will build on the foundation created by the Pittsburgh Workshops by providing our members with increasing access to some of the nation's most knowledgeable experts in information technologies and their effective use for learning, teaching, scholarship, and decision making.

The evidence is clear that CIC member colleges have accomplished a great deal with their resources. Given the access to information technologies available on member campuses, there is certainly widespread knowledge among them regarding the use of computers as personal productivity tools. There is also evidence of widespread use of emerging innovative technologies. Finally, campus networking and access to the Internet are making their presence felt. In short, CIC member colleges are well positioned to reap the benefits of emerging technologies. These technologies, in spite of the usual hype which surrounds them, are finally delivering on the ever present promises from the computer industry. They may in fact be used to enhance significantly learning, teaching, scholarship, and communication within the communities we call colleges.

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13	Less than 2 Academic Computing FTE per 1,000 Students is Typical
14	Salary Range: CIO
14	Salary Range: Dir of Administrative Computing
15	Salary Range: Dir of Academic Computing
15	Salary Range: Dir of Library
18	Student Microcomputer Access Is Rising Rapidly: Median #/1,000 Full+Part Time Students
19	Nearly All Colleges Offer Students Access to Computers in Computer Centers
19	PCs Are Accessible in Libraries in Well Over Half of 4-Year Institutions
20	Access to PCs in Residence Halls Appears to be Growing Rapidly
21	There Has Been Slow Growth in Classroom Use of Microcomputers
22	Three-quarters of Colleges Report Some Faculty Use Computer Software in Class
23	Less than Half Report Any Use of Multi-Media in Class
23	Less than One-quarter of Respondents Report Their Faculty Have Exclusive Use of a Computer
24	No Systematic Relationship between Internet Access and % of Faculty with Exclusive Access to a Computer
25	Connection to the Nation's Internet Is Rapidly Becoming Necessary to Stay Competitive
26	Median Number of Academic Microcomputers per 1,000 Students by Type
26	Median Number of Students per Academic Microcomputer by Type
27	Relatively Few Campuses Have One PC per User
28	IBM-Compatibles Dominate Academic Microcomputers
28	IBM-Compatibles Dominate Administrative Microcomputers
29	WordPerfect and MS Word Top the List of Wordprocessors
30	Lotus 1-2-3 Dominates Spreadsheet Use
30	dBase Dominates Database Management Use
31	There Is Little Use of Windowing Environments Beyond Microsoft Windows and Macintosh
32	Technologies Used by Respondents
33	Technologies Used by Respondents: Continued
33	A Large % of Colleges Have Satellite Downlinks, Few Have Uplinks
34	Most Campuses Have Local PBXs and Over a Quarter Use Them for Data
34	A Variety of Network Protocols Are Used
35	A Variety of Network Protocols Are Used: Continued
37	Educational Computing Market Share
37	Administrative Computing Market Share
38	Over Half the 4-Year Institutions Offer PCs to Students at a Discount

Appendix I

Representativeness of Respondents

One hundred nineteen out the three hundred eleven CIC members at the time of the survey filled out the questionnaire for a response rate of 38.3%. We were able to compare respondents to non-respondents using data from the College Board's 1991-92 Survey of Colleges and Universities. Members classified as Comprehensive II under the Carnegie Classification were more likely to respond (48%) than members with other classifications. The response rates for these other classifications were: Comprehensive I (33%), Liberal Arts I (33%), and Liberal Arts II (37%). Both of the CIC's Doctoral Granting II members responded. Given these differences in response rates it is not surprising to find that the respondents' median size was slightly larger than that of non-respondents (962 full-time undergraduates in 1991-92 versus 885 full-time undergraduates respectively). The median 1991-92 tuition and fees for respondents - $7,950 - was also slightly higher than the median of non-respondents - $7,750.

The College Board survey provides limited information regarding the use of computers, the subject of this report. The following table suggests that, for all indicators except one, students at respondent schools are slightly more likely to have access to computers.

	Respondents	Non-Respondents
Number of microcomputers per 1,000 full-time undergraduates	64.2	58.5
Number of microcomputers per 1,000 full-time and part-time undergraduates	49.2	44.5
% of members with access to computers in:		
Residence halls	16%	15%
Libraries	68%	65%
Classrooms	51%	56%
Computer Centers	98%	95%
% of members who provide computers to students at discounted price	50%	46%

While it is not possible to determine the true extent to which respondents differ from non-respondents regarding the use of information technologies, it appears that respondents have invested slightly more than non-respondents in these technologies. To the extent this is the case, then to that extent the results reported in the body of the paper would overestimate use of information technologies at CIC colleges.

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